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(54) **METHOD FOR INDEPENDENTLY CONTROLLING HUE OR SATURATION OF INDIVIDUAL COLORS IN A REAL TIME DIGITAL VIDEO IMAGE**

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(57) **ABSTRACT**

A method for independently controlling hue or saturation of individual colors in a real time digital video image, without affecting the hue or saturation of any other color in the same real time digital video image. Includes selecting a uniquely defined independent color hue control delta value or independent color saturation control delta value, where the delta value represents an extent or magnitude of change in hue or saturation, respectively, of the selected individual color, and, separately evaluating uniquely defined independent color hue control functions or independent color saturation control functions, using input image pixel values of the plurality of input image pixels identified as having the individual color in the real time digital video input image whose hue or saturation was selected to be independently changed, and using the corresponding selected independent color hue control delta value or the corresponding selected independent color saturation control delta value, respectively, for forming and displaying a corresponding plurality of output image pixels having the individual color whose hue or saturation was selected to be independently changed.

32 Claims, No Drawings

**Pl's Trial
Exhibit**

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METHOD FOR INDEPENDENTLY CONTROLLING HUE OR SATURATION OF INDIVIDUAL COLORS IN A REAL TIME DIGITAL VIDEO IMAGE

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to color control of real time digital video images and, more particularly, to a method for independently controlling hue or saturation of individual colors in a real time digital video image, without affecting the hue and saturation of any other color in the same real time digital video image.

Controlling colors in a displayed real time digital video image is typically performed by changing the hue, and/or, by increasing or decreasing the saturation of the colors or color components of the real time digital video image. Herein, an 'individual color' represents a linear combination of colors or color components, such as red, green, blue, yellow, cyan, and magenta, where, in RGB color space, the basic colors or color components are red, green, and blue, which are used for defining and evaluating the complementary colors or color components yellow, cyan, and magenta, and, in YCM color space, the basic colors or color components are yellow, cyan, and magenta, which are used for defining and evaluating the complementary colors or color components red, green, and blue. Herein, the term 'hue' refers to the angle between one color or color component and other colors or color components characterized in a particular color space, for example, RGB color space, featuring a color based three-dimensional coordinate system, within a real time digital video input image. Hue is also referred to as tint, or, as a gradation or shade of a color or color component. Herein, the term 'saturation' refers to the intensity of a color or color component characterized in a particular color space, for example, RGB color space, featuring a color based three-dimensional coordinate system, within a real time digital video input image. Saturation is also referred to as vividness of hue.

Different formats are used for characterizing colors or color components in real time digital video images. In one format, real time digital video images feature colors or color components characterized by linear combinations of the basic colors red, green, and blue, in RGB color space. In another format, real time digital video images feature colors or color components characterized by linear combinations of the basic colors yellow, cyan, and magenta, in YCM color space. In still another format, real time digital video images feature colors or color components characterized by linear combinations of the chromatic parts, Cr and Cb, also known in the art as U and V, respectively, in YCrCb or YUV luminance/chromatic color space, respectively. As is well known in the art, one format of a real time digital video image display can be transformed to another format by using appropriate linear combination functions.

In applications involving display of a real time digital video image, a user may desire to adjust or change the hue or saturation of an individual (single) color or color component of the real time digital video image, without affecting the hue or saturation of any other color or color component of the same real time digital video image. For example, a user may desire to adjust the hue or saturation of only one color, such as red, green, blue, yellow, magenta, or, cyan, of a real time digital video image displayed on a television screen, by pushing or turning a color hue or color saturation

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or intensity control button or dial on a control device associated with the television screen. Unfortunately, however, controlling hue or saturation of an individual color by this procedure affects the hue and/or saturation of all the colors or color components of the television image, and not just the hue or saturation of the individual color desired to be changed by the user.

In PCT International Patent Application Publication No. WO/00052938, published Sep. 08, 2000, taking priority from U.S. patent application Ser. No. 09/261,193, filed Mar. 03, 1999, now U.S. Pat. No. 6,122,012, by the same inventor of the present invention, there is disclosed a "Method Of Selective Color Control Of Digital Video Images". The disclosed method features using simple Look-Up-Tables (LUTs), whose values are calculated from uniquely defined color control functions, to digitally change the saturation or intensity of a single color of the chromatic part of a digital video image without affecting the saturation or intensity of any other color of the chromatic part of the same digital video image. A digital video input image is scanned, row by row, pixel by pixel. Each input image pixel value, defined from the chromatic part of the digital video input image, is assigned an address to be operated on by values in individual color LUTs. For a desired change in an individual color of that image, a new digital video output image is produced featuring the desired change in the individual color without affecting the remaining colors of that same image. Application of the disclosed method to display of digital video images precludes the need to convert video components (for example, YCrCb) into RGB (red, green, blue) components.

Selective color control using the just described method enables viewers of real time digital video images to do two things currently not achievable using conventional methods of color control of real time digital video images. Firstly, to very accurately set or adjust individual colors of a given real time digital video image to the actual colors of the subject of the image, and, secondly, to very accurately modify or alter colors of a given video image to produce desired special effects in that real time digital video image.

However, the just described method is notably limited because there is description of selectively controlling only the saturation or intensity, and not the hue, of individual colors of real time digital video images. Additionally, the disclosed method is based on using an algorithm which is particularly described with respect to real time digital video images featuring colors or color components characterized by linear combinations of the chromatic parts, Cr and Cb, or, U and V, in YCrCb or YUV luminance/chromatic color space, and there is no particular description with respect to other formats of real time digital video images, such as the RGB or YCM color space formats.

To date, the inventor is not aware of prior art teaching of a method for independently controlling hue of individual colors in a real time digital video image, without affecting the hue and/or saturation of other colors in the same real time digital video image.

There is thus a need for, and it would be highly advantageous to have a method for independently controlling hue or saturation of individual colors in a real time digital video image, without affecting the hue or saturation of any other color in the same real time digital video image. Moreover, there is a need for such a method for controlling color of real time digital video images which is efficient and robust, and is particularly applicable to real time digital video images featuring colors or color components characterized by linear combinations of the basic colors of red, green, and blue, in RGB color space.

SUMMARY OF THE INVENTION

The present invention relates to a method for independently controlling hue or saturation of individual colors in a real time digital video image, without affecting the hue or saturation of any other color in the same real time digital video image.

Thus, according to the present invention, there is provided a method for independently controlling hue or saturation of individual colors in a real time digital video image, comprising the steps of: (a) receiving and characterizing the real time digital video input image featuring input image pixels; (b) selecting to independently change the hue or the saturation of an individual color in the real time digital video input image, by selecting an independent color hue control delta value or an independent color saturation control delta value, respectively, wherein the independent color hue control delta value represents an extent of change in the hue of the selected individual color and wherein the independent color saturation control delta value represents an extent of change in the saturation of the selected individual color; (c) identifying a plurality of the input image pixels having the selected individual color in the real time digital video input image with the hue or the saturation selected to be independently changed, by performing arithmetic and logical operations using input image pixel values of each input image pixel of the real time digital video input image; (d) determining corresponding output image pixel values for each of the plurality of the input image pixels identified as having the selected individual color in the real time digital video input image with the hue or the saturation selected to be independently changed, by separately evaluating independent color hue control functions or independent color saturation control functions, respectively, using the input image pixel values of the plurality of the input image pixels, and using corresponding selected independent color hue control delta value or the corresponding selected independent color saturation control delta value, for forming a corresponding plurality of output image pixels having the selected individual color with the hue or the saturation selected to be independently changed; and (e) displaying a real time digital video output image including the corresponding plurality of the output image pixels having the selected individual color with the hue or the saturation selected to be independently changed in the real time digital video input image, whereby the hue or the saturation of the selected individual color in the real time digital video input image has been changed without affecting the hue or the saturation of any other individual color in the real time digital video input image.

According to another aspect of the present invention, there is provided a system for independently controlling hue or saturation of individual colors in a real time digital video image, comprising: (a) a real time digital video image display device displaying the real time digital video image featuring input image pixels; (b) a master control device in operative electronic communication with and controlling the real time digital video image display device; and (c) a viewer of the real time digital video image display device operating the master control device for selecting to independently change the hue or the saturation of an individual color in the real time digital video input image, by selecting an independent color hue control delta value or an independent color saturation control delta value featured on the master control device, respectively, wherein the independent color hue control delta value represents an extent of change in the hue of the selected individual color and wherein the independent color saturation control delta value represents an

extent of change in the saturation of the selected individual color, whereby the real time digital video image display device in the operative electronic communication with the master control device performs steps including: (i) identifying a plurality of the input image pixels having the selected individual color in the real time digital video input image with the hue or the saturation selected to be independently changed, by performing arithmetic and logical operations using input image pixel values of each input image pixel of the real time digital video input image; (ii) determining corresponding output image pixel values for each of the plurality of the input image pixels identified as having the selected individual color in the real time digital video input image with the hue or the saturation selected to be independently changed, by separately evaluating independent color hue control functions or independent color saturation control functions, respectively, using the input image pixel values of the plurality of the input image pixels, and using corresponding selected independent color hue control delta value or the corresponding selected independent color saturation control delta value, for forming a corresponding plurality of output image pixels having the selected individual color with the hue or the saturation selected to be independently changed; and (iii) displaying a real time digital video output image including the corresponding plurality of the output image pixels having the selected individual color with the hue or the saturation selected to be independently changed in the real time digital video input image, whereby the hue or the saturation of the selected individual color in the real time digital video input image has been changed without affecting the hue or the saturation of any other individual color in the real time digital video input image.

According to further features in preferred embodiments of the invention described below, the real time digital video input image is of a format selected from the group consisting of RGB format, YCrCb format, and, YUV format, whereby the individual colors of one format can be characterized by the individual colors of a second format by using appropriate linear transformations between the formats.

According to further features in preferred embodiments of the invention described below, the real time digital video input image features basic colors red, green, and blue, and, complementary colors yellow, cyan, and magenta, in RGB color space, whereby values of the complementary colors are expressed in terms of and evaluated from linear combinations of values of the basic colors.

According to further features in preferred embodiments of the invention described below, the real time digital video input image features basic colors yellow, cyan, and magenta, and, complementary colors red, green, and blue, in YCM color space, whereby values of the complementary colors are expressed in terms of and evaluated from linear combinations of values of the basic colors.

The present invention successfully overcomes limitations of presently known techniques and methods for real time controlling color, in general, and independently controlling color components such as hue and saturation, in particular, of real time digital video images. Independently controlling hue or saturation of individual colors in a real time digital video image, without affecting the hue or saturation of any other color in the same real time digital video image, enables viewers of video images to do two things currently not achievable using conventional methods for controlling color of real time digital video images. Firstly, to very accurately, yet independently, change or adjust the hue or saturation of individual colors of a given real time digital video image

according to the actual hue or saturation of individual colors of the subject of the real time digital video image, and, secondly, to very accurately, yet independently, modify or alter the hue or saturation of individual colors of a given video image to produce desired special effects in the real time digital video image. These benefits of the present invention are immediately applicable to the television and movie industries, where it is critically important for real time digital video images to represent actual hue or saturation of individual colors of a real time digital video image, and to have the capability of producing special effects to real time digital video images.

Implementation of the method of the present invention for independently controlling hue or saturation of individual colors in a real time digital video image, without affecting the hue or saturation of any other color in the same real time digital video image involves performing or completing selected tasks or steps manually, automatically, or a combination thereof. Moreover, according to actual instrumentation and/or equipment used for implementing a particular preferred embodiment of the disclosed method, several selected steps of the present invention could be performed by hardware, by software on any operating system of any firmware, or a combination thereof. In particular, as hardware, selected steps of the invention could be performed by a computerized network, a computer, a computer chip, an electronic circuit, hard-wired circuitry, or a combination thereof, involving any number of digital and/or analog, electrical and/or electronic, components, operations, and protocols. Additionally, or alternatively, as software, selected steps of the invention could be performed by a data processor, such as a computing platform, executing a plurality of computer program types of software instructions or protocols using any suitable computer operating system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to a method for independently controlling hue or saturation of individual colors in a real time digital video image, without affecting the hue or saturation of any other color in the same real time digital video image.

The method of the present invention introduces the novelty of independently controlling hue, in addition to, but separate from, controlling saturation, of individual colors in a real time digital video image, without affecting the hue or saturation of any other color in the same real time digital video image. This is accomplished, in part, by selecting a uniquely defined independent color hue control delta value or a uniquely defined independent color saturation control delta value, where the delta value represents an extent or magnitude of change in hue or saturation, respectively, of the selected individual color, and, in part, by separately evaluating uniquely defined independent color hue control functions or uniquely defined independent color saturation control functions, using input image pixel values of the plurality of input image pixels identified as having the individual color in the real time digital video input image whose hue or saturation was selected to be independently changed, and using the corresponding selected independent color hue control delta value or the corresponding selected independent color saturation control delta value, respectively, for forming and displaying a corresponding plurality of output image pixels having the individual color whose hue or saturation was selected to be independently changed.

It is to be understood that the invention is not limited in its application to the details of the order or sequence of steps

of operation or implementation, set forth in the following description. For example, the following description particularly refers to real time digital video images featuring colors or color components characterized by linear combinations of the basic colors red, green, and, blue, in RGB color space, which are used for defining and evaluating the complementary colors or color components yellow, cyan, and magenta, in the RGB color space, in order to illustrate implementation of the present invention. The method of the present invention is applicable to other formats of real time digital video images featuring colors or color components characterized by individual colors or color components in other types of color space, such as real time digital video images featuring colors or color components characterized by linear combinations of the basic colors yellow, cyan, and magenta, in YCM color space, or, real time digital video images featuring color components characterized by chromatic parts, Cr and Cb, or, U and V, in YCrCb or YUV luminance/chromatic color space, by applying appropriate linear transformations between the RGB color space and the YCM, or, the YCrCb or YUV luminance/chromatic color space. Accordingly, the invention is capable of other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

The method for independently controlling hue or saturation of individual colors in a real time digital video image, of the present invention, is herein disclosed for the first time, and is neither anticipated or obviously derived from the "Method Of Selective Color Control Of Digital Video Images", as disclosed by same inventor in PCT International Patent Application Publication No. WO/00052938, or in the priority U.S. Pat. No. 6,122,012.

Steps, components, operation, and implementation of the method for independently controlling hue or saturation of individual colors in a real time digital video image, according to the present invention, are better understood with reference to the following description.

In Step (a) of the method of the present invention, there is receiving and characterizing a real time digital video input image.

Preferably, there is receiving a real time digital video input image, I, featuring colors or color components characterized by linear combinations of the basic colors red, green, and blue, in RGB color space, whereby the real time digital video input image, I, features basic colors red, green, and blue, and, complementary colors yellow, cyan, and magenta, in the RGB color space featuring a color based three-dimensional coordinate system. As previously described above, the method of the present invention is applicable to other formats, such as YCM, YCrCb, or YUV formats, of real time digital video images featuring colors or color components characterized by individual colors or color components in other types of color space, such as YCM, YCrCb or YUV color spaces, respectively, by using appropriate linear transformations between color spaces.

Accordingly, for RGB color space, $I[i,j: R_{in}, G_{in}, B_{in}]$ represents each of a plurality of input image pixels of the real time digital video input image, I, which can be plotted in an input grid of a real time digital video image display device, whose position coordinates in the input grid are indicated by row i, and column j. For the real time digital video input image, I, of size M rows by N columns, position indices (i,j) are preferably limited to the input image size as follows: i: 0,1,2, . . . M-1; and j: 0,1,2, . . . N-1. In general, indices i and j are real or integer.

For each input image pixel, $I[i,j]$: R_{in} , G_{in} , B_{in} , individual basic colors or color components, red, green, and blue, have color or color component values represented by the terms R_{in} , G_{in} , and B_{in} , respectively, and, individual complementary colors or color components yellow, cyan, and magenta, have color or color component values represented by the terms Y_{in} , C_{in} , and M_{in} , respectively. Color or color component values, Y_{in} , C_{in} , and M_{in} , of the individual complementary colors or color components, yellow, cyan, and magenta, respectively, are expressed in terms of, and evaluated from, linear combinations of the color or color component values, R_{in} , G_{in} , and B_{in} , of the individual basic colors or color components, red, green, and blue, respectively.

In Step (b), there is selecting to independently change hue or saturation of an individual color in the real time digital video input image, by selecting an independent color hue control delta value or an independent color saturation control delta value, respectively, where the independent color hue control delta value represents an extent or magnitude of change in hue of the selected individual color, and, where the independent color saturation control delta value represents an extent or magnitude of change in saturation of the selected individual color.

In particular, there is selecting to independently change, that is, change clockwise or counterclockwise, hue, or, to independently change, that is, increase or decrease, saturation, of an individual color, such as red, green, blue, yellow, cyan, or, magenta, in the real time digital video input image, I , displayed on the video image display device.

The extent or magnitude of change in hue, herein, also referred to as 'H', of the selected individual color, herein also referred to as 'clr', is represented by an independent color hue control delta value, herein generally indicated as $Hclr$, where the term 'clr' is symbolic of a particular selected individual color, such as red, green, blue, yellow, cyan, or, magenta, in the real time digital video input image, I . Accordingly, there is an independent color hue control delta value, $Hclr$, assigned to each color or color component in the real time digital video input image, I , whose hue is potentially to be changed. Thus, with respect to RGB color space, there is Hr , Hg , Hb , Hy , Hc , and Hm , representing the independent color hue control delta values of red, green, blue, yellow, cyan, and, magenta, respectively.

In principle, the numerical range, represented by an interval, $[h1, h2]$, where $h1$ and $h2$ are integers, of the independent color hue control delta value, $Hclr$, in general, and of each Hr , Hg , Hb , Hy , Hc , and Hm , in particular, is arbitrary. For implementation, preferably, the numerical range of $Hclr$, in general, and of each Hr , Hg , Hb , Hy , Hc , and Hm , in particular, is between -1 and $+1$, corresponding to the interval $[-1, +1]$, which is equivalent to any other interval, $[h1, h2]$, by performing linear or non-linear transformation between these particular intervals.

The extent or magnitude of change in saturation, herein, also referred to by 'S', of the selected individual color, clr , is represented by an independent color saturation control delta value, herein generally indicated as $Sclr$, where, as previously described, the term 'clr' is symbolic of a particular selected individual color, such as red, green, blue, yellow, cyan, or, magenta, in the real time digital video input image, I . Accordingly, there is an independent color saturation control delta value, $Sclr$, assigned to each color or color component in the real time digital video input image, I , whose saturation is potentially to be changed. Thus, with respect to RGB color space, there is Sr , Sg , Sb , Sy , Sc , and

Sm , representing the independent color saturation control delta values of red, green, blue, yellow, cyan, and, magenta, respectively.

In principle, the numerical range, represented by an interval, $[s1, s2]$, where $s1$ and $s2$ are integers, of the independent color saturation control delta value, $Sclr$, in general, and of each Sr , Sg , Sb , Sy , Sc , and Sm , in particular, is arbitrary. For implementation, preferably, the numerical range of $Sclr$, in general, and of each Sr , Sg , Sb , Sy , Sc , and Sm , in particular, is between -1 and $+1$, corresponding to the interval $[-1, +1]$, which is equivalent to any other interval, $[s1, s2]$, by performing linear or non-linear transformation between these particular intervals.

Accordingly, the operative result of Step (b) is that of selecting either an independent color hue control delta value, $Hclr$, or, an independent color saturation delta value, $Sclr$, which is not zero, that is, where only one of the following is selected at a given time: $Hclr > 0$ (changing color hue clockwise), or, $Hclr < 0$ (changing color hue counterclockwise), or, $Sclr > 0$ (increasing color saturation), or, $Sclr < 0$ (decreasing color saturation), thereby, indicating an independent change in either hue or saturation of the selected individual color is to be made by continuing with the following steps.

As previously indicated above, a main aspect of novelty of the present invention is that of enabling one to independently control, that is, to independently change or adjust, by increasing or decreasing, hue or saturation of each individual color in a real time digital video image, without affecting the hue or saturation of any other color in the same real time digital video image. Accordingly, as part of implementing the method, there is using the independent color hue control delta value, $Hclr$, or, the independent color saturation control delta value, $Sclr$, where the delta value represents an extent or magnitude of change in hue or saturation of a particular selected individual color, and, where the independent color hue control delta value is completely independent or separate from the independent color saturation control delta value. More specifically stated, selecting to independently change hue of a particular individual color by a particular extent or magnitude, represented by $Hclr$, is completely independent or separate from, and, has no effect on the hue of any other color in the same real time digital video image, or, on the saturation of the particular selected individual color in the same real time digital video image. Additionally, selecting to independently change saturation of a particular individual color by a particular extent or magnitude, represented by $Sclr$, is completely independent or separate from, and, has absolutely no effect on the saturation of any other color in the same real time digital video image, or, on the hue of the particular selected individual color in the same real time digital video image.

Consistent with each respective definition, whereby the independent color hue control delta value, $Hclr$, and, the independent color saturation delta value, $Sclr$, each represent an extent or magnitude of change in hue or saturation, respectively, of a selected individual color, the respective delta values therefore represent a finite increment in hue or saturation, where hue and saturation of the individual colors or color components of the real time digital video input image, I , are variable within respective ranges of hue and saturation. Without going into details of color theory and applications thereof, which are well known to those skilled in the art of video imaging and video image processing, the independent color hue control delta value, $Hclr$, used in the method of the present invention, is herein defined to be proportional to the extent or magnitude of change, or, the

finite increment, of the hue or angle of a selected individual color or color component in a direction, clockwise or counterclockwise, towards other individual colors or color components, characterized in a particular color space, for example, RGB color space, featuring a color based three-dimensional coordinate system, within the real time digital video input image, I. Additionally, the independent color saturation control delta value, Sclr, used in the method of the present invention, is herein defined to be proportional to the extent or magnitude of change, or, the finite increment, increasing or decreasing, of the saturation or intensity of an individual color or color component, characterized in the same color space, for example, RGB color space, featuring the color based three-dimensional coordinate system, within the real time digital video input image, I.

Specific ranges, and values, of hue and saturation of the individual colors or color components featured in the real time digital video input image are typically pre-determined or set according to design and manufacture of hardware and/or software of a particular real time digital video display device and associated equipment and peripherals, such as a built-in color controller, or, a wireless remote color controller, used for operating the particular real time digital video display device. Accordingly, for implementing the method of the present invention, specific ranges, and values, in particular, [h1, h2], of the independent color hue control delta value, Hclr, and, specific ranges, and values, in particular, [s1, s2], of the independent color saturation delta value, Sclr, are also pre-determined or set according to design and manufacture of hardware and/or software of the particular real time digital video display device and associated equipment and peripherals used for operating the particular real time digital video display device.

In Step (c), there is identifying a plurality of the input image pixels having the individual color in the real time digital video input image whose hue or saturation was selected to be independently changed, by performing arithmetic and logical operations using input image pixel values of each input image pixel of the real time digital video input image.

More specifically, there is identifying a plurality of the input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, in the real time digital video input, I, image having the individual color in the real time digital video input image whose hue or saturation was selected to be independently changed, by performing arithmetic and logical operations selected from the group consisting of addition, subtraction, multiplication, division, equal to, greater than, less than, absolute value of, and, combinations thereof, using input image pixel values, R_{in}, G_{in}, B_{in} , of each input image pixel, $I[i,j: R_{in}, G_{in}, B_{in}]$, of the real time digital video input image. Six cases of Step (c) are described, corresponding to the six colors or color components, red, green, blue, yellow, cyan, and, magenta, associated with the input image pixel values, R_{in}, G_{in}, B_{in} , respectively, of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, of the real time digital video input image, I, characterized by RGB color space. In Step (c) and hereinafter, where applicable, the asterisk symbol, *, represents the mathematical operation of multiplication, and, the double bars symbol, | |, represents the mathematical operation of absolute value of the value indicated inside the double bars.

It is emphasized that this step is for identifying only, and not for changing or affecting, input image pixels having the individual color in the real time digital video input image whose hue or saturation was selected to be independently changed. Moreover, according to the result of previously described Step (b), for selecting to independently change

hue or saturation of an individual color in the real time digital video input image, only one of the following described six cases is implemented according to that selection, whereby, only one independent color hue control delta value, Hclr, or, only one independent color saturation delta value, Sclr, of Step (b), is not equal to zero, during a given time or sequence of image processing, for identifying input image pixels having the selected individual color.

In each case 1 through 6, of Step (c), below, the plurality of input image pixels in the real time digital video input image is preferably scanned, row by row, pixel by pixel, for identifying the plurality of input image pixels having the individual color in the real time digital video input image whose hue or saturation was selected to be independently changed. For implementation, either following identifying each input image pixel, one at a time, or, following identifying the entire plurality of input image pixels, as having the individual color in the real time digital video input image whose hue or saturation was selected to be independently changed, each identified input image pixel, or, the identified entire plurality of input image pixels (for example, after saving the entire plurality of identified input image pixels in a memory), respectively, is further processed, by continuing with next Step (d).

In case 1, where the independent red hue control delta value, Hr, or, the independent red saturation delta value, Sr, of Step (b), is not equal to zero, there is identifying each input image pixel having red, R, as the individual color whose hue or saturation was selected to be independently changed, according to the following logical conditions:

$R_{in} > [Arg + G_{in}]$ and $R_{in} > [Arb + B_{in}]$, where Arg and Arb are positive constants.

Then, there is continuing with Step (d) below.

In case 2, where the independent green hue control delta value, Hg, or, the independent green saturation delta value, Sg, of Step (b), is not equal to zero, there is identifying each input image pixel having green, G, as the individual color whose hue or saturation was selected to be independently changed, according to the following logical conditions:

$G_{in} > [Agr + R_{in}]$ and $G_{in} > [Agb + B_{in}]$, where Agr and Agb are positive constants.

Then, there is continuing with Step (d) below.

In case 3, where the independent blue hue control delta value, Hb, or, the independent blue saturation delta value, Sb, of Step (b), is not equal to zero, there is identifying each input image pixel having blue, B, as the individual color whose hue or saturation was selected to be independently changed, according to the following logical conditions:

$B_{in} > [Abg + G_{in}]$ and $B_{in} > [Abr + R_{in}]$, where Abg and Abr are positive constants.

Then, there is continuing with Step (d) below.

In case 4, where the independent yellow hue control delta value, Hy, or, the independent yellow saturation delta value, Sy, of Step (b), is not equal to zero, there is identifying each input image pixel having yellow, Y, as the individual color whose hue or saturation was selected to be independently changed, according to the following logical conditions:

$R_{in} > [Arby + B_{in}]$ and $G_{in} > [Agby + B_{in}]$ and $|R_{in} - G_{in}| < Ty$, where Arby, Agby, and Ty, are positive constants.

Then, there is continuing with Step (d) below.

In case 5, where the independent cyan hue control delta value, Hc, or, the independent cyan saturation delta value, Sc, of Step (b), is not equal to zero, there is identifying each input image pixel having cyan, C, as the individual color whose hue or saturation was selected to be independently changed, according to the following logical condition:

$G_{in} > [Agrc + R_{in}]$ and $B_{in} > [Abrc + R_{in}]$ and $|G_{in} - B_{in}| < Tb$, where $Agrc$, $Abrc$, and Tb , are positive constants.

Then, there is continuing with Step (d) below.

In case 6, where the independent magenta hue control delta value, Hm , or, the independent magenta saturation delta value, Sm , of Step (b), is not equal to zero, there is identifying each input image pixel having magenta, M , as the individual color whose hue or saturation was selected to be independently changed, according to the following logical condition:

$R_{in} > [Argm + G_{in}]$ and $B_{in} > [Abgm + G_{in}]$ and $|R_{in} - B_{in}| < Tm$, where $Argm$, $Abgm$, and Tm , are positive constants.

Then, there is continuing with Step (d) below.

In Step (d), there is determining corresponding output image pixel values for each of the plurality of input image pixels identified as having the individual color in the real time digital video input image whose hue or saturation was selected to be independently changed, by separately evaluating independent color hue control functions or independent color saturation control functions, respectively, using the input image pixel values of the plurality of input image pixels identified as having the individual color in the real time digital video input image whose hue or saturation was selected to be independently changed, and using the corresponding selected independent color hue control delta value or the corresponding selected independent color saturation control delta value, respectively, for forming a corresponding plurality of output image pixels having the individual color whose hue or saturation was selected to be independently changed.

For RGB color space, $O[s,t: R_{out}, G_{out}, B_{out}]$ represents each of a plurality of output image pixels of the real time digital video output image, O , which can be plotted in an output grid of a real time digital video image display device, whose position coordinates in the output grid are indicated by row s , and column t . For the real time digital video output image, O , of size M' rows by N' columns, position indices (s,t) are preferably limited to the output image size as follows: $s: 0,1,2, \dots M'-1$; and $t: 0,1,2, \dots N'-1$. In general, indices s and t are real or integer.

For each output image pixel, $O[s,t: R_{out}, G_{out}, B_{out}]$, individual basic colors or color components, red, green, and blue, have color or color component values represented by the terms R_{out} , G_{out} , and B_{out} , respectively, and, individual complementary colors or color components yellow, cyan, and magenta, have color or color component values represented by the terms Y_{out} , C_{out} , and M_{out} , respectively. As previously indicated in Step (a) above, color or color component values, Y_{out} , C_{out} , and M_{out} , of the individual complementary colors or color components, yellow, cyan, and magenta, respectively, are expressed in terms of, and evaluated from, linear combinations of the color or color component values, R_{out} , G_{out} , and B_{out} , of the individual basic colors or color components, red, green, and blue, respectively.

Accordingly, in Step (d), more specifically, there is determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified, according to previously described Step (c), as having the individual color in the real time digital video input image whose hue or saturation was selected to be independently changed, by separately evaluating independent color hue control functions, $F_h(\text{color-hue})$, or, independent color saturation control functions, $F_s(\text{color-saturation})$, respectively, using the input image pixel values, R_{in} , G_{in} , B_{in} , of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having the individual color in the real

time digital video input image whose hue or saturation was selected to be independently changed, and using the corresponding selected independent color hue control delta value, $Hclr$, or the corresponding selected independent color saturation control delta value, $Sclr$, respectively, for forming a corresponding plurality of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having the individual color whose hue or saturation was selected to be independently changed.

Except for the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having the individual color in the real time digital video input image whose hue or saturation was selected to be independently changed, the hue or saturation of no other color is affected in the remaining plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, in the same real time digital video input image.

For implementation, either following determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each input image pixel, $I[i,j: R_{in}, G_{in}, B_{in}]$, one at a time, or, following determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for the entire plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having the individual color in the real time digital video input image whose hue or saturation was selected to be independently changed, each determined output image pixel, $O[s,t: R_{out}, G_{out}, B_{out}]$, or, the identified entire plurality of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, (for example, after saving the entire plurality of determined output image pixels in a memory), respectively, is further processed, by continuing with next Step (e).

In Step (d), two scenarios, scenario (A), for independently changing, clockwise or counterclockwise, hue of an individual color in the real time digital video input image, I , and, scenario (B), for independently changing, increasing or decreasing, saturation of an individual color in the real time digital video input image, I , are described herein. Only one scenario, scenario (A), or, scenario (B), is operative during a given time or sequence of processing the real time digital video input image, I , according to the result of previously described Step (b), for selecting to independently change hue or saturation of an individual color in the real time digital video input image, I . Additionally, for each scenario, (A) and (B), six particular cases are described, corresponding to each of the three individual basic colors or color components, red, green, and blue, and, to each of the three individual complementary colors or color components, yellow, cyan, and magenta, associated with the input image pixel values, R_{in} , G_{in} , B_{in} , respectively, of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, of the real time digital video input image, I , characterized by RGB color space.

In scenario (A), there is determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having the individual color in the real time digital video input image whose hue was selected to be independently changed, clockwise or counterclockwise, according to the non-zero independent color hue control delta value, $Hclr$, previously selected in Step (b), above.

First, in scenario (A), for independently controlling hue only of an individual color, there is described a first generalized algorithm, featuring evaluating independent color hue control functions, $F_h(\text{color-hue})$, applicable to the three particular cases corresponding to permutations, that is, RGB, GBR, and, BRG, of the three individual basic colors or color components, red, green, and, blue, associated with the input image pixel values, R_{in} , G_{in} , and, B_{in} , respectively, of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, of the real time digital video input image, I , characterized by RGB color

space, and using the corresponding selected independent color hue control delta value, Hclr, for forming a corresponding plurality of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having the individual color whose hue was selected to be independently changed.

For $Hclr > 0$ (changing color hue clockwise towards $Vclr1_{in}$ and $Vclr2_{in}$)

$$F_1(\text{color-hue}) = [(1-Hclr) * Vclr1_{in} + (Hclr * Vclr2_{in})],$$

$$F_2(\text{color-hue}) = [(1-Hclr) * Vclr2_{in} + (Hclr * Vclr1_{in})],$$

$$F_3(\text{color-hue}) = Vclr3_{in};$$

For $Hclr < 0$ (changing color hue counterclockwise towards $Vclr1_{in}$ and $Vclr3_{in}$)

Hclr is set equal to $-Hclr$, and

$$F_1(\text{color-hue}) = [(1-Hclr) * Vclr1_{in} + (Hclr * Vclr3_{in})],$$

$$F_2(\text{color-hue}) = Vclr2_{in},$$

$$F_3(\text{color-hue}) = [(1-Hclr) * Vclr3_{in} + (Hclr * Vclr1_{in})];$$

for forming:

$$Vclr1_{out} = F_1(\text{color-hue}),$$

$$Vclr2_{out} = F_2(\text{color-hue}), \text{ and}$$

$$Vclr3_{out} = F_3(\text{color-hue}),$$

where Hclr corresponds to the independent color hue control delta value previously defined and selected in Step (b), above, specifically, of the current selected individual color, clr, and, in particular, of the current selected individual color red, green, or, blue; the $F_h(\text{color-hue})$, for $h=1$ to 3, are independent color hue control functions; $Vclr1_{in}$, $Vclr2_{in}$, and $Vclr3_{in}$, are input image pixel values of the three individual basic colors, clr1, clr2, and clr3, respectively, and, in particular, are used for permuting R_{in} , G_{in} , and B_{in} , of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, of the real time digital video input image, I, characterized by RGB color space; and, $Vclr1_{out}$, $Vclr2_{out}$, and $Vclr3_{out}$, are corresponding output image pixel values of the three individual basic colors, clr1, clr2, and clr3, respectively, and, in particular, are used for similarly permuting R_{out} , G_{out} , and B_{out} , of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, of the real time digital video output image, O, characterized by RGB color space.

In case 1 of scenario (A), where the independent red hue control delta value, Hr, of Step (b), is not equal to zero, there is determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having red as the individual color in the real time digital video input image whose hue was selected to be independently changed, by separately evaluating independent red hue control functions, $F_h(\text{red-hue})$, using the input image pixel values, R_{in} , G_{in} , B_{in} , of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having red as the individual color in the real time digital video input image whose hue was selected to be independently changed, for forming a set of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having red as the individual color whose hue was selected to be independently changed. In case 1, the previously described first generalized algorithm, above, is applied, where the colors, clr1, clr2, clr3, correspond to the particular color permutation of R, G, B, respectively, as follows:

For $Hr > 0$ (changing red hue clockwise towards yellow and green)

$$F_1(\text{red-hue}) = [(1-Hr) * R_{in} + (Hr * G_{in})],$$

$$F_2(\text{red-hue}) = [(1-Hr) * G_{in} + (Hr * R_{in})],$$

$$F_3(\text{red-hue}) = B_{in};$$

For $Hr < 0$ (changing red hue counterclockwise towards magenta and blue)

Hr is set equal to $-Hr$, and

$$F_1(\text{red-hue}) = [(1-Hr) * R_{in} + (Hr * B_{in})],$$

$$F_2(\text{red-hue}) = G_{in},$$

$$F_3(\text{red-hue}) = [(1-Hr) * B_{in} + (Hr * R_{in})];$$

for forming:

$$R_{out} = F_1(\text{red-hue}),$$

$$G_{out} = F_2(\text{red-hue}), \text{ and}$$

$$B_{out} = F_3(\text{red-hue}),$$

where all the necessary input data and information are known for determining all of the corresponding output image pixel values for each output image pixel.

Changing red hue of the real time digital video input image, I, whereby $Hr > 0$, corresponds to changing red color, R, of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, clockwise towards yellow and green colors in the RGB color space featuring the color based three-dimensional coordinate system, for forming the real time digital video output image, O, featuring the corresponding plurality of digital output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having red as the individual color whose hue was selected to be independently increased. Changing red hue of the real time digital video input image, I, whereby $Hr < 0$, corresponds to changing red color, R, of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, counterclockwise towards magenta and blue colors in the RGB color space featuring the color based three-dimensional coordinate system, for forming the real time digital video output image, O, featuring the corresponding plurality of digital output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having red as the individual color whose hue was selected to be independently decreased.

In case 2 of scenario (A), where the independent green hue control delta value, Hg, of Step (b), is not equal to zero, there is determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having green as the individual color in the real time digital video input image whose hue was selected to be independently changed, by separately evaluating independent red hue control functions, $F_h(\text{green-hue})$, using the input image pixel values, R_{in} , G_{in} , B_{in} , of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having green as the individual color in the real time digital video input image whose hue was selected to be independently changed, for forming a set of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having green as the individual color whose hue was selected to be independently changed. In case 2, the previously described first generalized algorithm, above, is applied, where the colors, clr1, clr2, clr3, correspond to the particular color permutation of G, B, R, respectively, as follows:

For $Hg > 0$ (changing green hue clockwise towards cyan and blue)

$$F_1(\text{green-hue}) = [(1-Hg) * G_{in} + (Hg * B_{in})],$$

$$F_2(\text{green-hue}) = [(1-Hg) * B_{in} + (Hg * G_{in})],$$

$$F_3(\text{green-hue}) = R_{in};$$

For $Hg < 0$ (changing green hue counterclockwise towards yellow and red)

Hg is set equal to $-Hg$, and

$$F_1(\text{green-hue}) = [(1-Hg) * G_{in} + (Hg * R_{in})],$$

$$F_2(\text{green-hue}) = B_{in},$$

$$F_3(\text{green-hue}) = [(1-Hg) * R_{in} + (Hg * G_{in})];$$

for forming:

$$G_{out} = F_1(\text{green-hue}),$$

$$B_{out} = F_2(\text{green-hue}), \text{ and}$$

$$R_{out} = F_3(\text{green-hue}),$$

where all the necessary input data and information are known for determining all of the corresponding output image pixel values for each output image pixel.

Changing green hue of the real time digital video input image, I, whereby $H_g > 0$, corresponds to changing green color, G, of the plurality of input image pixels, $[i,j: R_{in}, G_{in}, B_{in}]$, clockwise towards cyan and blue colors in the RGB color space featuring the color based three-dimensional coordinate system, for forming the real time digital video output image, O, featuring the corresponding plurality of digital output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having green as the individual color whose hue was selected to be independently increased. Changing green hue of the real time digital video input image, I, whereby $H_g < 0$, corresponds to changing green color, G, of the plurality of input image pixels, $[i,j: R_{in}, G_{in}, B_{in}]$, counterclockwise towards yellow and red colors in the RGB color space featuring the color based three-dimensional coordinate system, for forming the real time digital video output image, O, featuring the corresponding plurality of digital output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having green as the individual color whose hue was selected to be independently decreased.

In case 3 of scenario (A), where the independent blue hue control delta value, H_b , of Step (b), is not equal to zero, there is determining corresponding output image pixel values, $R_{out}, G_{out}, B_{out}$, for each of the plurality of input image pixels, $[i,j: R_{in}, G_{in}, B_{in}]$, identified as having blue as the individual color in the real time digital video input image whose hue was selected to be independently changed, by separately evaluating independent blue hue control functions, $F_h(\text{color-hue})$, using the input image pixel values, R_{in}, G_{in}, B_{in} , of the plurality of input image pixels, $[i,j: R_{in}, G_{in}, B_{in}]$, identified as having blue as the individual color in the real time digital video input image whose hue was selected to be independently changed, for forming a set of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having blue as the individual color whose hue was selected to be independently changed. In case 3, the previously described first generalized algorithm, above, is applied, where the colors, $\text{clr1}, \text{clr2}, \text{clr3}$, correspond to the particular color permutation of B, R, G, respectively, as follows:

For $H_b > 0$ (changing blue hue clockwise towards magenta and red)

$$F_1(\text{blue-hue}) = [(1-H_b) * B_{in} + (H_b * R_{in})],$$

$$F_2(\text{blue-hue}) = [(1-H_b) * R_{in} + (H_b * B_{in})],$$

$$F_3(\text{blue-hue}) = G_{in};$$

For $H_b < 0$ (changing blue hue counterclockwise towards cyan and green)

H_b is set equal to $-H_b$, and

$$F_1(\text{blue-hue}) = [(1-H_b) * B_{in} + (H_b * G_{in})],$$

$$F_2(\text{blue-hue}) = R_{in},$$

$$F_3(\text{blue-hue}) = [(1-H_b) * G_{in} + (H_b * B_{in})];$$

for forming:

$$B_{out} = F_1(\text{blue-hue}),$$

$$R_{out} = F_2(\text{blue-hue}), \text{ and}$$

$$G_{out} = F_3(\text{blue-hue}),$$

where all the necessary input data and information are known for determining all of the corresponding output image pixel values for each output image pixel.

Changing blue hue of the real time digital video input image, I, whereby $H_b > 0$, corresponds to changing blue color, B, of the plurality of input image pixels, $[i,j: R_{in}, G_{in}, B_{in}]$, clockwise towards magenta and red colors in the RGB color space featuring the color based three-dimensional coordinate system, for forming the real time digital video output image, O, featuring the corresponding plurality of digital output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having blue as the individual color whose hue was selected to be

independently increased. Changing blue hue of the real time digital video input image, I, whereby $H_b < 0$, corresponds to changing blue color, B, of the plurality of input image pixels, $[i,j: R_{in}, G_{in}, B_{in}]$, counterclockwise towards cyan and green colors in the RGB color space featuring the color based three-dimensional coordinate system, for forming the real time digital video output image, O, featuring the corresponding plurality of digital output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having blue as the individual color whose hue was selected to be independently decreased.

Second, in scenario (A), for independently controlling hue only of an individual color, there is described a second generalized algorithm, featuring evaluating independent color hue control functions, $F_h(\text{color-hue})$, applicable to the remaining three particular cases corresponding to permutations, that is, YCM, CMY, and, MYC, of the three individual complementary colors or color components, yellow, cyan, and, magenta, expressed in terms of linear combinations of the individual basic colors or color components red, green, and blue, associated with the input image pixel values, R_{in}, G_{in} , and, B_{in} , of input image pixels, $[i,j: R_{in}, G_{in}, B_{in}]$, of the real time digital video input image, I, characterized by RGB color space, for forming a corresponding plurality of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having the individual color whose hue was selected to be independently changed.

$$\text{Vclr4}_{in} = (\text{Vclr1}_{in} + \text{Vclr2}_{in})/2,$$

$$\text{Vclr5}_{in} = (\text{Vclr2}_{in} + \text{Vclr3}_{in})/2,$$

$$\text{Vclr6}_{in} = (\text{Vclr1}_{in} + \text{Vclr3}_{in})/2;$$

For $\text{Hclr} > 0$ (changing color hue clockwise towards Vclr4_{in} and Vclr5_{in})

$$F_1(\text{color-hue}) = [((1-\text{Hclr}) * \text{Vclr4}_{in}) + (\text{Hclr} * \text{Vclr5}_{in})],$$

$$F_2(\text{color-hue}) = [((1-\text{Hclr}) * \text{Vclr5}_{in}) + (\text{Hclr} * \text{Vclr4}_{in})],$$

$$F_3(\text{Color-hue}) = [\text{Vclr6}_{in}];$$

For $\text{Hclr} < 0$ (changing color hue counterclockwise towards Vclr4_{in} and Vclr6_{in})

Hclr is set equal to $-\text{Hclr}$, and

$$F_1(\text{color-hue}) = [((1-\text{Hclr}) * \text{Vclr4}_{in}) + (\text{Hclr} * \text{Vclr6}_{in})],$$

$$F_2(\text{color-hue}) = [((1-\text{Hclr}) * \text{Vclr6}_{in}) + (\text{Hclr} * \text{Vclr4}_{in})],$$

$$F_3(\text{color-hue}) = [\text{Vclr5}_{in}];$$

for forming:

$$\text{Vclr1}_{out} = F_1(\text{color-hue}) - F_2(\text{color-hue}) + F_3(\text{color-hue}),$$

$$\text{Vclr2}_{out} = F_1(\text{color-hue}) + F_2(\text{color-hue}) - F_3(\text{color-hue}),$$

and

$$\text{Vclr3}_{out} = -F_1(\text{color-hue}) + F_2(\text{color-hue}) + F_3(\text{color-hue}),$$

where Hclr corresponds to the independent color hue control delta value previously defined and selected in Step (b), above, specifically, of the current selected individual color, dr, and, in particular, of the current selected individual color yellow, cyan, or, magenta; the $F_h(\text{color-hue})$, for $h=1$ to 3, are independent color hue control functions; Vclr1_{in} , Vclr2_{in} , and Vclr3_{in} , are input image pixel values of the three individual basic colors, clr1 , clr2 , and clr3 , respectively, and, in particular, are used for permuting R_{in} , G_{in} , and B_{in} , of input image pixels, $[i,j: R_{in}, G_{in}, B_{in}]$, of the real time digital video input image, I, characterized by RGB color space; Vclr4_{in} , Vclr5_{in} , and Vclr6_{in} , are values of the three individual complementary colors, clr4 , clr5 , and, clr6 , respectively, and, in particular, are used for permuting values of yellow, cyan, and magenta, Y_{in} , C_{in} , M_{in} , respectively, expressed in terms of, and evaluated from, linear combinations of the color or color component values, R_{in} , G_{in} , and B_{in} ; and, Vclr1_{out} , Vclr2_{out} , Vclr3_{out} , are corresponding output image pixel values of the three individual basic colors, clr1 , clr2 , and, clr3 , respectively, and, in

particular, represent the same permutation of R_{in} , G_{in} , and B_{in} , but, of R_{out} , G_{out} , B_{out} , of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, of the real time digital video output image, O , characterized by RGB color space.

In case 4 of scenario (A), where the independent yellow hue control delta value, H_y , of Step (b), is not equal to zero, there is determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having yellow as the individual color in the real time digital video input image whose hue was selected to be independently changed, by separately evaluating independent yellow hue control functions, F_h (yellow-hue), using the input image pixel values, R_{in} , G_{in} , B_{in} , of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having yellow as the individual color in the real time digital video input image whose hue was selected to be independently changed, for forming a set of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having yellow as the individual color whose hue was selected to be independently changed. In case 4, the previously described second generalized algorithm, above, is applied, where the colors, $clr1$, $clr2$, $clr3$, correspond to the particular color permutation of R, G, B, respectively, and, the colors, $clr4$, $clr5$, $clr6$, correspond to the particular color permutation of Y, C, M, respectively, as follows:

$$Y_{in} = (R_{in} + G_{in})/2,$$

$$C_{in} = (G_{in} + B_{in})/2,$$

$$M_{in} = (R_{in} + B_{in})/2;$$

For $H_y > 0$ (changing yellow hue clockwise towards green and cyan)

$$F_1(\text{yellow-hue}) = [(1 - H_y) * Y_{in}] + (H_y * C_{in}),$$

$$F_2(\text{yellow-hue}) = [(1 - H_y) * C_{in}] + (H_y * Y_{in}),$$

$$F_3(\text{yellow-hue}) = [M_{in}];$$

For $H_y < 0$ (changing yellow hue counterclockwise towards red and magenta)

H_y is set equal to $-H_y$, and

$$F_1(\text{yellow-hue}) = [(1 - H_y) * Y_{in}] + (H_y * M_{in}),$$

$$F_2(\text{yellow-hue}) = [(1 - H_y) * M_{in}] + (H_y * Y_{in}),$$

$$F_3(\text{yellow-hue}) = [C_{in}];$$

for forming:

$$R_{out} = F_1(\text{yellow-hue}) - F_2(\text{yellow-hue}) + F_3(\text{yellow-hue}),$$

$$G_{out} = F_1(\text{yellow-hue}) + F_2(\text{yellow-hue}) - F_3(\text{yellow-hue}),$$

and

$$B_{out} = -F_1(\text{yellow-hue}) + F_2(\text{yellow-hue}) + F_3(\text{yellow-hue}),$$

where all the necessary input data and information are known for determining all of the corresponding output image pixel values for each output image pixel.

Changing yellow hue of the real time digital video input image, I , whereby $H_y > 0$, corresponds to changing yellow color, Y , of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, clockwise towards green and cyan colors in the RGB color space featuring the color based three-dimensional coordinate system, for forming the real time digital video output image, O , featuring the corresponding plurality of digital output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having yellow as the individual color whose hue was selected to be independently increased. Changing yellow hue of the real time digital video input image, I , whereby $H_y < 0$, corresponds to changing yellow color, Y , of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, counterclockwise towards red and magenta colors in the RGB color space featuring the color based three-dimensional coordinate system, for forming the real time digital video output image, O , featuring the corresponding plurality of digital output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having yellow as the individual color whose hue was selected to be independently decreased.

In case 5 of scenario (A), where the independent cyan hue control delta value, H_c , of Step (b), is not equal to zero, there is determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having cyan as the individual color in the real time digital video input image whose hue was selected to be independently changed, by separately evaluating independent cyan hue control functions, F_h (cyan-hue), using the input image pixel values, R_{in} , G_{in} , B_{in} , of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having cyan as the individual color in the real time digital video input image whose hue was selected to be independently changed, for forming a set of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having cyan as the individual color whose hue was selected to be independently changed. In case 5, the previously described second generalized algorithm, above, is applied, where the colors, $clr1$, $clr2$, $clr3$, correspond to the particular color permutation of G, B, R, respectively, and, the colors, $clr4$, $clr5$, $clr6$, correspond to the particular color permutation of C, M, Y, respectively, as follows:

$$C_{in} = (G_{in} + B_{in})/2,$$

$$M_{in} = (B_{in} + R_{in})/2,$$

$$Y_{in} = (G_{in} + R_{in})/2,$$

For $H_c > 0$ (changing cyan hue clockwise towards blue and magenta)

$$F_1(\text{cyan-hue}) = [(1 - H_c) * C_{in}] + (H_c * M_{in}),$$

$$F_2(\text{cyan-hue}) = [(1 - H_c) * M_{in}] + (H_c * C_{in}),$$

$$F_3(\text{cyan-hue}) = [Y_{in}];$$

For $H_c < 0$ (changing cyan hue counterclockwise towards green and yellow)

H_c is set equal to $-H_c$, and

$$F_1(\text{cyan-hue}) = [(1 - H_c) * C_{in}] + (H_c * Y_{in}),$$

$$F_2(\text{cyan-hue}) = [(1 - H_c) * Y_{in}] + (H_c * C_{in}),$$

$$F_3(\text{cyan-hue}) = [M_{in}];$$

for forming:

$$G_{out} = F_1(\text{cyan-hue}) - F_2(\text{cyan-hue}) + F_3(\text{cyan-hue}),$$

$$B_{out} = -F_1(\text{cyan-hue}) + F_2(\text{cyan-hue}) - F_3(\text{cyan-hue}),$$

$$R_{out} = -F_1(\text{cyan-hue}) + F_2(\text{cyan-hue}) + F_3(\text{cyan-hue}),$$

where all the necessary input data and information are known for determining all of the corresponding output image pixel values for each output image pixel.

Changing cyan hue of the real time digital video input image, I , whereby $H_c > 0$, corresponds to changing cyan color, C , of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, clockwise towards blue and magenta colors in the RGB color space featuring the color based three-dimensional coordinate system, for forming the real time digital video output image, O , featuring the corresponding plurality of digital output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having cyan as the individual color whose hue was selected to be independently increased. Changing cyan hue of the real time digital video input image, I , whereby $H_c < 0$, corresponds to changing cyan color, C , of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, counterclockwise towards green and yellow colors in the RGB color space featuring the color based three-dimensional coordinate system, for forming the real time digital video output image, O , featuring the corresponding plurality of digital output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having cyan as the individual color whose hue was selected to be independently decreased.

In case 6 of scenario (A), where the independent magenta hue control delta value, H_m , of Step (b), is not equal to zero, there is determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each of the plurality of input

image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in}], identified as having magenta as the individual color in the real time digital video input image whose hue was selected to be independently changed, by separately evaluating independent cyan hue control functions, $F_h(\text{magenta-hue})$, using the input image pixel values, R_{in} , G_{in} , B_{in} , of the plurality of input image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in}], identified as having magenta as the individual color in the real time digital video input image whose hue was selected to be independently changed, for forming a set of output image pixels, $O[s,t]$: R_{out} , G_{out} , B_{out}], having magenta as the individual color whose hue was selected to be independently changed. In case 6, the previously described second generalized algorithm, above, is applied, where the colors, $clr1$, $clr2$, $clr3$, correspond to the particular color permutation of B, R, G, respectively, and, the colors, $clr4$, $clr5$, $clr6$, correspond to the particular color permutation of M, Y, C, respectively, as follows:

$M_{in} = (B_{in} + R_{in})/2$,
 $Y_{in} = (R_{in} + G_{in})/2$,
 $C_{in} = (B_{in} + G_{in})/2$;
 For $Hm > 0$ (changing magenta hue clockwise towards red and yellow)

$F_1(\text{magenta-hue}) = [(1-Hm) * M_{in}] + (Hm * Y_{in})$,
 $F_2(\text{magenta-hue}) = [(1-Hm) * Y_{in}] + (Hm * M_{in})$,
 $F_3(\text{magenta-hue}) = [C_{in}]$;
 For $Hm < 0$ (changing magenta hue counterclockwise towards blue and cyan)

Hm is set equal to $-Hm$, and
 $F_1(\text{magenta-hue}) = [(1-Hm) * M_{in}] + (Hm * C_{in})$,
 $F_2(\text{magenta-hue}) = [(1-Hm) * C_{in}] + (Hm * M_{in})$,
 $F_3(\text{magenta-hue}) = [Y_{in}]$.

for forming:

$B_{out} = F_1(\text{magenta-hue}) - F_2(\text{magenta-hue}) + F_3(\text{magenta-hue})$,
 $R_{out} = F_1(\text{magenta-hue}) + F_2(\text{magenta-hue}) - F_3(\text{magenta-hue})$, and
 $G_{out} = -F_1(\text{magenta-hue}) + F_2(\text{magenta-hue}) + F_3(\text{magenta-hue})$,

where all the necessary input data and information are known for determining all of the corresponding output image pixel values for each output image pixel.

Changing magenta hue of the real time digital video input image, I , whereby $Hm > 0$, corresponds to changing magenta color, M , of the plurality of input image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in}], clockwise towards red and yellow colors in the RGB color space featuring the color based three-dimensional coordinate system, for forming the real time digital video output image, O , featuring the corresponding plurality of digital output image pixels, $O[s,t]$: R_{out} , G_{out} , B_{out}], having magenta as the individual color whose hue was selected to be independently increased. Changing magenta hue of the real time digital video input image, I , whereby $Hm < 0$, corresponds to changing magenta color, M , of the plurality of input image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in}], counterclockwise towards blue and cyan colors in the RGB color space featuring the color based three-dimensional coordinate system, for forming the real time digital video output image, O , featuring the corresponding plurality of digital output image pixels, $O[s,t]$: R_{out} , G_{out} , B_{out}], having magenta as the individual color whose hue was selected to be independently decreased.

In scenario (B), there is determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each of the plurality of input image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in}], identified as having the individual color in the real time digital video input image

whose saturation was selected to be independently changed, by increasing or decreasing, according to the non-zero independent color saturation control delta value, $Sclr$, previously selected in Step (b), above.

First, in scenario (B), for independently controlling saturation only of an individual color, there is described a third generalized algorithm, featuring evaluating independent color saturation control functions, $F_s(\text{color-saturation})$, applicable to the three particular cases corresponding to permutations, that is, RGB, GBR, and, BRG, of the three individual basic colors or color components, red, green, and, blue, associated with the input image pixel values, R_{in} , G_{in} , and, B_{in} , respectively, of input image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in}], of the real time digital video input image, I , characterized by RGB color space, and using the corresponding selected independent color saturation control delta value, $Sclr$, for forming a corresponding plurality of output image pixels, $O[s,t]$: R_{out} , G_{out} , B_{out}], having the individual color whose saturation was selected to be independently changed.

For $Sclr > 0$ (increasing color saturation)

$F_1(\text{color-saturation}) = Vclr1_{in} + [Sclr * (D_{RM} - Vclr1_{in})]$,
 $F_2(\text{color-saturation}) = Vclr2_{in} - 0.5 * [Sclr * (D_{RM} - Vclr1_{in})]$,
 or, alternatively,

$F_2(\text{color-saturation}) = Vclr2_{in}$, and
 $F_3(\text{color-saturation}) = Vclr3_{in} - 0.5 * [Sclr * (D_{RM} - Vclr1_{in})]$,
 or, alternatively,

$F_3(\text{color-saturation}) = Vclr3_{in}$;
 For $Sclr < 0$ (decreasing color saturation)

$F_1(\text{color-saturation}) = Vclr1_{in} + [Sclr * (\text{minimum}[|Vclr1_{in} - Vclr2_{in}|, |Vclr1_{in} - Vclr3_{in}|])]$,

$F_2(\text{color-saturation}) = Vclr2_{in}$, and
 $F_3(\text{color-saturation}) = Vclr3_{in}$;

for forming:

$Vclr1_{out} = F_1(\text{color-saturation})$,
 $Vclr2_{out} = F_2(\text{color-saturation})$, and
 $Vclr3_{out} = F_3(\text{color-saturation})$,

where $Sclr$ corresponds to the independent color saturation control delta value previously defined and selected in Step (b), above, specifically, of the current selected individual color, clr , and, in particular, of the current selected individual color red, green, or, blue; the $F_s(\text{color-saturation})$, for $s=1$ to 3, are independent color saturation control functions; D_{RM} , is a color saturation control parameter, preferably, proportional to the maximum value of the dynamic range of the color level of the real time digital video input image; $Vclr1_{in}$, $Vclr2_{in}$, and $Vclr3_{in}$, are input image pixel values of the three individual basic colors, $clr1$, $clr2$, and $clr3$, respectively, and, in particular, are used for permuting R_{in} , G_{in} , and B_{in} , of input image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in}], of the real time digital video input image, I , characterized by RGB color space; $Vclr1_{out}$, $Vclr2_{out}$, and $Vclr3_{out}$, are corresponding output image pixel values of the three individual basic colors, $clr1$, $clr2$, and $clr3$, respectively, and, in particular, are used for similarly permuting R_{out} , G_{out} , and B_{out} , of output image pixels, $O[s,t]$: R_{out} , G_{out} , B_{out}], of the real time digital video output image, O , characterized by RGB color space, and, as previously stated above, the asterisk symbol, $*$, represents the mathematical operation of multiplication, and, the double bars symbol, $| |$, represents the mathematical operation of absolute value of the value indicated inside the double bars.

As indicated above, D_{RM} is a color saturation control parameter, preferably, proportional to the maximum value of the dynamic range of the color level of the real time digital video input image. In particular, D_{RM} is proportional to the

maximum value of the dynamic range of pixel values between the black level and the white level of the real time digital video input image, and is a function of the number of bits (for example, 6, 8, or 10 bits) per pixel of a given individual color or color component of the real time digital video input image. For example, preferably, for implementing the method of the present invention, the dynamic range is in terms of 8 bits per pixel, which results in a value of the dynamic range, -128 to +127. Adding an offset control, for example, an offset control equal to +128, to the dynamic range, results in an adjusted dynamic range of 0 to 255, with the maximum value of 255, which, in the method of the present invention, is preferably used as the value of the color saturation control parameter, D_{RM} . Accordingly, for the dynamic range of the color level of the real time digital video input image expressed in terms of 9 bits, 10 bits, or, 11 bits, the color saturation control parameter, D_{RM} , is assigned the value of 511, 1023, or, 2023, respectively.

In case 1 of scenario (B), where the independent red saturation control delta value, S_r , of Step (b), is not equal to zero, there is determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each of the plurality of input image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in} , identified as having red as the individual color in the real time digital video input image whose saturation was selected to be independently changed, by separately evaluating independent red saturation control functions, F_s (red-saturation), using the input image pixel values, R_{in} , G_{in} , B_{in} , of the plurality of input image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in} , identified as having red as the individual color in the real time digital video input image whose saturation was selected to be independently changed, for forming a set of output image pixels, $O[s,t]$: R_{out} , G_{out} , B_{out} , having red as the individual color whose saturation was selected to be independently changed. In case 1, the previously described third generalized algorithm, above, is applied, where the colors, $clr1$, $clr2$, $clr3$, correspond to the particular color permutation of R, G, B, respectively, as follows:

For $S_r > 0$ (increasing red saturation)

$$F_1(\text{red-saturation}) = R_{in} + [S_r * (D_{RM} - R_{in})],$$

$$F_2(\text{red-saturation}) = G_{in} - 0.5 * [S_r * (D_{RM} - R_{in})], \text{ or, alternatively,}$$

$$F_2(\text{red-saturation}) = G_{in}, \text{ and}$$

$$F_3(\text{red-saturation}) = B_{in} - 0.5 * [S_r * (D_{RM} - R_{in})], \text{ or, alternatively,}$$

$$F_3(\text{red-saturation}) = B_{in};$$

For $S_r < 0$ (decreasing red saturation)

$$F_1(\text{red-saturation}) = R_{in} + [S_r * (\text{minimum}[|R_{in} - G_{in}|, |R_{in} - B_{in}|])],$$

$$F_2(\text{red-saturation}) = G_{in}, \text{ and}$$

$$F_3(\text{red-saturation}) = B_{in};$$

for forming:

$$R_{out} = F_1(\text{red-saturation}),$$

$$G_{out} = F_2(\text{red-saturation}), \text{ and}$$

$$B_{out} = F_3(\text{red-saturation}),$$

where all the necessary input data and information are known for determining all of the corresponding output image pixel values for each output image pixel.

In case 2 of scenario (B), where the independent green saturation control delta value, S_g , of Step (b), is not equal to zero, there is determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each of the plurality of input image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in} , identified as having green as the individual color in the real time digital video input image whose saturation was selected to be independently

changed, by separately evaluating independent green saturation control functions, F_s (green-saturation), using the input image pixel values, R_{in} , G_{in} , B_{in} , of the plurality of input image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in} , identified as having green as the individual color in the real time digital video input image whose saturation was selected to be independently changed, for forming a set of output image pixels, $O[s,t]$: R_{out} , G_{out} , B_{out} , having green as the individual color whose saturation was selected to be independently changed. In case 2, the previously described third generalized algorithm, above, is applied, where the colors, $clr1$, $clr2$, $clr3$, correspond to the particular color permutation of G, B, R, respectively, as follows:

For $S_g > 0$ (increasing green saturation)

$$F_1(\text{green-saturation}) = G_{in} + [S_g * (D_{RM} - G_{in})],$$

$$F_2(\text{green-saturation}) = B_{in} - 0.5 * [S_g * (D_{RM} - G_{in})], \text{ or, alternatively,}$$

$$F_2(\text{green-saturation}) = B_{in}, \text{ and}$$

$$F_3(\text{green-saturation}) = R_{in} - 0.5 * [S_g * (D_{RM} - G_{in})], \text{ or, alternatively,}$$

$$F_3(\text{green-saturation}) = R_{in};$$

For $S_g < 0$ (decreasing green saturation)

$$F_1(\text{green-saturation}) = G_{in} + [S_g * (\text{minimum}[|G_{in} - B_{in}|, |G_{in} - R_{in}|])],$$

$$F_2(\text{green-saturation}) = B_{in}, \text{ and}$$

$$F_3(\text{green-saturation}) = R_{in};$$

for forming:

$$G_{out} = F_1(\text{green-saturation}),$$

$$B_{out} = F_2(\text{green-saturation}), \text{ and}$$

$$R_{out} = F_3(\text{green-saturation}),$$

where all the necessary input data and information are known for determining all of the corresponding output image pixel values for each output image pixel.

In case 3 of scenario (B), where the independent blue saturation control delta value, S_b , of Step (b), is not equal to zero, there is determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each of the plurality of input image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in} , identified as having blue as the individual color in the real time digital video input image whose saturation was selected to be independently changed, by separately evaluating independent blue saturation control functions, F_s (blue-saturation), using the input image pixel values, R_{in} , G_{in} , B_{in} , of the plurality of input image pixels, $I[i,j]$: R_{in} , G_{in} , B_{in} , identified as having blue as the individual color in the real time digital video input image whose saturation was selected to be independently changed, for forming a set of output image pixels, $O[s,t]$: R_{out} , G_{out} , B_{out} , having blue as the individual color whose saturation was selected to be independently changed. In case 3, the previously described third generalized algorithm, above, is applied, where the colors, $clr1$, $clr2$, $clr3$, correspond to the particular color permutation of B, R, G, respectively, as follows:

For $S_b > 0$ (increasing blue saturation)

$$F_1(\text{blue-saturation}) = B_{in} + [S_b * (D_{RM} - B_{in})],$$

$$F_2(\text{blue-saturation}) = R_{in} - 0.5 * [S_b * (D_{RM} - B_{in})], \text{ or, alternatively,}$$

$$F_2(\text{blue-saturation}) = R_{in}, \text{ and}$$

$$F_3(\text{blue-saturation}) = G_{in} - 0.5 * [S_b * (D_{RM} - B_{in})], \text{ or, alternatively,}$$

$$F_3(\text{blue-saturation}) = G_{in};$$

For $S_b < 0$ (decreasing blue saturation)

$$F_1(\text{blue-saturation}) = B_{in} + [S_b * (\text{minimum}[|B_{in} - R_{in}|, |B_{in} - G_{in}|])],$$

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$F_2(\text{blue-saturation})=R_{in}$, and
 $F_3(\text{blue-saturation})=G_{in}$;
 for forming:

$B_{out}=F_1(\text{blue-saturation})$,
 $R_{out}=F_2(\text{blue-saturation})$, and
 $G_{out}=F_3(\text{blue-saturation})$,

where all the necessary input data and information are known for determining all of the corresponding output image pixel values for each output image pixel.

Second, in scenario (B), for independently controlling saturation only of an individual color, there is described a fourth generalized algorithm, featuring evaluating independent color saturation control functions, $F_s(\text{color-saturation})$, applicable to the remaining three particular cases corresponding to permutations, that is, YCM, CMY, and MYC, of the three individual complementary colors or color components, yellow, cyan, and, magenta, expressed in terms of linear combinations of the individual basic colors or color components red, green, and blue, associated with the input image pixel values, R_{in} , G_{in} , and, B_{in} , of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, of the real time digital video input image, I , characterized by RGB color space, for forming a corresponding plurality of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having the individual color whose saturation was selected to be independently changed.

For $Sclr>0$ (increasing color saturation)

$F_1(\text{color-saturation})=Vclr1_{in}+0.5*[Sclr*(D_{RM}-\text{maximum}[Vclr1_{in}, Vclr2_{in}])]$,

$F_2(\text{color-saturation})=Vclr2_{in}+0.5*[Sclr*(D_{RM}-\text{maximum}[Vclr1_{in}, Vclr2_{in}])]$, and

$F_3(\text{color-saturation})=Vclr3_{in}-[Sclr*(D_{RM}-\text{maximum}[Vclr1_{in}, Vclr2_{in}])]$, or, alternatively,

$F_3(\text{color-saturation})=Vclr3_{in}$;

For $Sclr<0$ (decreasing color saturation)

$F_1(\text{color-saturation})=Vclr1_{in}-[Sclr*(\text{minimum}[Vclr1_{in}-Vclr3_{in}, |Vclr2_{in}-Vclr3_{in}|])]$,

$F_2(\text{color-saturation})=Vclr2_{in}+[Sclr*(\text{minimum}[Vclr1_{in}-Vclr3_{in}, |Vclr2_{in}-Vclr3_{in}|])]$, and

$F_3(\text{color-saturation})=Vclr3_{in}$;

for forming:

$Vclr1_{out}=F_1(\text{color-saturation})$,

$Vclr2_{out}=F_2(\text{color-saturation})$, and

$Vclr3_{out}=F_3(\text{color-saturation})$,

where $Sclr$ corresponds to the independent color saturation control delta value previously defined and selected in Step (b), above, specifically, of the current selected individual color, clr , and, in particular, of the current selected individual color yellow, cyan, or, magenta; the $F_s(\text{color-saturation})$, for $s=1$ to 3, are independent color saturation control functions; D_{RM} , is the previously defined color saturation control parameter; $Vclr1_{in}$, $Vclr2_{in}$ and $Vclr3_{in}$, are input image pixel values of the three individual basic colors, $clr1$, $clr2$, and $clr3$, respectively, and, in particular, are used for permuting R_{in} , G_{in} , and B_{in} , of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, of the real time digital video input image, I , characterized by RGB color space; and, $Vclr1_{out}$, $Vclr2_{out}$ and $Vclr3_{out}$, are corresponding output image pixel values of the three individual basic colors, $clr1$, $clr2$, and $clr3$, respectively, and, in particular, are used for similarly permuting R_{out} , G_{out} , and B_{out} , of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, of the real time digital video output image, O , characterized by RGB color space.

In case 4 of scenario (B), where the independent yellow saturation control delta value, Sy , of Step (b), is not equal to zero, there is determining corresponding output image pixel

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values, R_{out} , G_{out} , B_{out} , for each of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having yellow as the individual color in the real time digital video input image whose saturation was selected to be independently changed, by separately evaluating independent red saturation control functions, $F_s(\text{yellow-saturation})$, using the input image pixel values, R_{in} , G_{in} , B_{in} , of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having yellow as the individual color in the real time digital video input image whose saturation was selected to be independently changed, for forming a set of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having yellow as the individual color whose saturation was selected to be independently changed. In case 4, the previously described fourth generalized algorithm, above, is applied, where the colors, $clr1$, $clr2$, $clr3$, correspond to the particular color permutation of R , G , B , respectively, as follows:

For $Sy>0$ (increasing yellow saturation)

$F_1(\text{yellow-saturation})=R_{in}+0.5*[Sy*(D_{RM}-\text{maximum}[R_{in}, G_{in}])]$,

$F_2(\text{yellow-saturation})=G_{in}+0.5*[Sy*(D_{RM}-\text{maximum}[R_{in}, G_{in}])]$, and

$F_3(\text{yellow-saturation})=B_{in}-[Sy*(D_{RM}-\text{maximum}[R_{in}, G_{in}])]$, or, alternatively,

$F_3(\text{yellow-saturation})=B_{in}$;

For $Sy<0$ (decreasing yellow saturation)

$F_1(\text{yellow-saturation})=R_{in}+[Sy*(\text{minimum}[|R_{in}-B_{in}|, |G_{in}-B_{in}|])]$,

$F_2(\text{yellow-saturation})=G_{in}+[Sy*(\text{minimum}[|R_{in}-B_{in}|, |G_{in}-B_{in}|])]$, and

$F_3(\text{yellow-saturation})=B_{in}$;

for forming:

$R_{out}=F_1(\text{yellow-saturation})$,

$G_{out}=F_2(\text{yellow-saturation})$, and

$B_{out}=F_3(\text{yellow-saturation})$,

where all the necessary input data and information are known for determining all of the corresponding output image pixel values for each output image pixel.

In case 5 of scenario (B), where the independent cyan saturation control delta value, Sc , of Step (b), is not equal to zero, there is determining corresponding output image pixel values, R_{out} , G_{out} , B_{out} , for each of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having cyan as the individual color in the real time digital video input image whose saturation was selected to be independently changed, by separately evaluating independent green saturation control functions, $F_s(\text{cyan-saturation})$, using the input image pixel values, R_{in} , G_{in} , B_{in} , of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having cyan as the individual color in the real time digital video input image whose saturation was selected to be independently changed, for forming a set of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having cyan as the individual color whose saturation was selected to be independently changed. In case 5, the previously described fourth generalized algorithm, above, is applied, where the colors, $clr1$, $clr2$, $clr3$, correspond to the particular color permutation of G , B , R , respectively, as follows:

For $Sc>0$ (increasing cyan saturation)

$F_1(\text{cyan-saturation})=G_{in}+0.5*[Sc*(D_{RM}-\text{maximum}[G_{in}, B_{in}])]$,

$F_2(\text{cyan-saturation})=B_{in}+0.5*[Sc*(D_{RM}-\text{maximum}[G_{in}, B_{in}])]$, and

$F_3(\text{cyan-saturation})=R_{in}-[Sc*(D_{RM}-\text{maximum}[G_{in}, B_{in}])]$, or, alternatively,

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$F_3(\text{cyan-saturation})=R_{in};$

For $Sc<0$ (decreasing cyan saturation)

$F_1(\text{cyan-saturation})=G_{in}+[Sc*(\text{minimum}[[G_{in}-R_{in}], |B_{in}-R_{in}|])],$

$F_2(\text{cyan-saturation})=B_{in}+[Sc*(\text{minimum}[[G_{in}-R_{in}], |B_{in}-R_{in}|])],$ and

$F_3(\text{cyan-saturation})=R_{in};$

for forming:

$G_{out}=F_1(\text{cyan-saturation}),$

$B_{out}=F_2(\text{cyan-saturation}),$ and

$R_{out}=F_3(\text{cyan-saturation}),$

where all the necessary input data and information are known for determining all of the corresponding output image pixel values for each output image pixel.

In case 6 of scenario (B), where the independent magenta saturation control delta value, Sm , of Step (b), is not equal to zero, there is determining corresponding output image pixel values, $R_{out}, G_{out}, B_{out}$, for each of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having magenta as the individual color in the real time digital video input image whose saturation was selected to be independently changed, by separately evaluating independent magenta saturation control functions, F_s (magenta-saturation), using the input image pixel values, R_{in}, G_{in}, B_{in} , of the plurality of input image pixels, $I[i,j: R_{in}, G_{in}, B_{in}]$, identified as having magenta as the individual color in the real time digital video input image whose saturation was selected to be independently changed, for forming a set of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, having magenta as the individual color whose saturation was selected to be independently changed. In case 6, the previously described fourth generalized algorithm, above, is applied, where the colors, $clr1, clr2, clr3$, correspond to the particular color permutation of B, R, G, respectively, as follows:

For $Sm>0$ (increasing magenta saturation)

$F_1(\text{magenta-saturation})=B_{in}+0.5*[Sm*(D_{RM}-\text{maximum}[[B_{in}, R_{in}]]),$

$F_2(\text{magenta-saturation})=R_{in}+0.5*[Sm*(D_{RM}-\text{maximum}[[B_{in}, R_{in}]]),$ and

$F_3(\text{magenta-saturation})=G_{in}-[Sm*(D_{RM}-\text{maximum}[[B_{in}, R_{in}]]),$ or, alternatively,

$F_3(\text{magenta-saturation})=G_{in};$

For $Sm<0$ (decreasing magenta saturation)

$F_1(\text{magenta-saturation})=B_{in}+[Sm*(\text{minimum}[[B_{in}-G_{in}], |R_{in}-G_{in}|])],$

$F_2(\text{magenta-saturation})=R_{in}+[Sm*(\text{minimum}[[B_{in}-G_{in}], |R_{in}-G_{in}|])],$ and

$F_3(\text{magenta-saturation})=G_{in};$

for forming:

$B_{out}=F_1(\text{magenta-saturation}),$

$R_{out}=F_2(\text{magenta-saturation}),$ and

$G_{out}=F_3(\text{magenta-saturation}),$

where all the necessary input data and information are known for determining all of the corresponding output image pixel values for each output image pixel.

In Step (e), there is displaying a real time digital video output image including the corresponding plurality of output image pixels having the individual color whose hue or saturation was selected to be independently changed in the real time digital video input image, whereby the hue or saturation of the selected individual color in the real time digital video input image has been changed.

More specifically, in Step (e), there is displaying the real time digital video output image, O , including the corre-

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sponding plurality of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, featuring output image pixel values, $R_{out}, G_{out}, B_{out}$, having the individual color whose hue or saturation was selected to be independently changed in the real time digital video input image, I , determined according to previously described Step (d), whereby the hue or saturation of the selected individual color in the real time digital video input image, I , has been changed, without affecting the hue or saturation of any other color in the same real time digital video input image, I .

For implementation, there is displaying the real time digital video output image, O , by displaying either each output image pixel, $O[s,t: R_{out}, G_{out}, B_{out}]$, one at a time, featuring output image pixel values, $R_{out}, G_{out}, B_{out}$, or, by displaying the entire plurality of output image pixels, $O[s,t: R_{out}, G_{out}, B_{out}]$, featuring output image pixel values, $R_{out}, G_{out}, B_{out}$, (for example, after saving the entire plurality of determined output image pixels in a memory), having the individual color whose hue or saturation was selected to be independently changed in the real time digital video input image, I .

As an exemplary system for implementing the just described method of the present invention is described herein. A user or viewer of a real time digital video image display device, such as a television screen, selects to independently change hue, H , or, selects to independently change saturation, S , of an individual color, clr , such as red, green, blue, yellow, cyan, or, magenta, in the real time digital video input image, I , displayed on the real time video image display device, by activating, such as by pushing or turning, an independent color hue control mechanism, or, an independent color saturation control mechanism, such as a button, dial, or graphic user interface (GUI) menu display, configured on a man-machine interaction (MMI) mechanism featured as part of a master control device, such as a built-in master color controller device, or, a wireless remote master color controller device, in operative electronic communication with the real time video image display device.

Alphanumerical data/information written or designed on the buttons, dials, or, graphic user interface (GUI) menu displays, configured on the man-machine interaction (MMI) mechanism, operatively correspond to the above described independent color hue control delta values, $Hclr$, and, independent color saturation control delta values, $Scclr$, where the alphanumerical data/information represents ranges of different extents or magnitudes of change in hue or saturation, respectively, of the individual color, clr , selected by the user or viewer.

Within seconds, following the user or viewer pushing or turning, the independent color hue control mechanism, or, the independent color saturation control mechanism, that is, following pushing or turning one of the buttons, dials, or, GUI menu displays, of the master control device, the real time digital video image display device in operative electronic communication with the master control device performs functions and operations according to the above described Steps (c) through (e) of the method of the present invention, whereby the real time video image display device, such as the television screen, displays the real time digital video output image including the individual color whose hue or saturation was selected to be independently changed in the real time digital video input image, whereby the hue or saturation of the selected individual color in the real time digital video input image has been changed, without affecting the hue or saturation of any other color in the same real time digital video input image.

While the invention has been described in conjunction with specific embodiments and examples thereof, it is evi-

dent that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims.

What is claimed is:

1. A method for independently controlling hue or saturation of individual colors in a real time digital video image, comprising the steps of:

- (a) receiving and characterizing the real time digital video input image featuring input image pixels;
- (b) selecting to independently change the hue or the saturation of an individual color in the real time digital video input image, by selecting an independent color hue control delta value or an independent color saturation control delta value, respectively, wherein said independent color hue control delta value represents an extent of change in the hue of said selected individual color and wherein said independent color saturation control delta value represents an extent of change in the saturation of said selected individual color;
- (c) identifying a plurality of said input image pixels having said selected individual color in the real time digital video input image with the hue or the saturation selected to be independently changed, by performing arithmetic and logical operations using input image pixel values of each said input image pixel of the real time digital video input image;
- (d) determining corresponding output image pixel values for each of said plurality of said input image pixels identified as having said selected individual color in the real time digital video input image with the hue or the saturation selected to be independently changed, by separately evaluating independent color hue control functions or independent color saturation control functions, respectively, using said input image pixel values of said plurality of said input image pixels, and using corresponding said selected independent color hue control delta value or said corresponding selected independent color saturation control delta value, for forming a corresponding plurality of output image pixels having said selected individual color with the hue or the saturation selected to be independently changed; and
- (e) displaying a real time digital video output image including said corresponding plurality of said output image pixels having said selected individual color with the hue or the saturation selected to be independently changed in the real time digital video input image, whereby the hue or the saturation of said selected individual color in the real time digital video input image has been changed without affecting the hue or the saturation of any other individual color in the real time digital video input image.

2. The method of claim 1, whereby the real time digital video input image is of a format selected from the group consisting of RGB format, YCrCb format, and, YUV format, whereby the individual colors of one said format can be characterized by the individual colors of a second said format by using appropriate linear transformations between said formats.

3. The method of claim 1, whereby the real time digital video input image features basic colors red, green, and blue, and, complementary colors yellow, cyan, and magenta, in RGB color space, whereby values of said complementary colors are expressed in terms of and evaluated from linear combinations of values of said basic colors.

4. The method of claim 1, whereby the real time digital video input image features basic colors yellow, cyan, and magenta, and, complementary colors red, green, and blue, in YCM color space, whereby values of said complementary colors are expressed in terms of and evaluated from linear combinations of values of said basic colors.

5. The method of claim 1, whereby in step (b), numerical range of said independent color hue control delta value and numerical range of said independent color saturation control delta value corresponds to an arbitrary interval of integers.

6. The method of claim 1, whereby in step (b), numerical range of said independent color hue control delta value is an interval between -1 and +1.

7. The method of claim 1, whereby in step (b), numerical range of said independent color saturation control delta value is an interval between -1 and +1.

8. The method of claim 1, whereby said independent color hue control delta value is completely independent and separate from said independent color saturation control delta value.

9. The method of claim 1, whereby said independent color saturation control delta value is completely independent and separate from said independent color hue control delta value.

10. The method of claim 1, whereby in step (b), said extent of change in the hue of said selected individual color is selected from the group consisting of a clockwise change and a counterclockwise change, of an angle of said selected individual color towards other individual colors characterized in a color space featuring a color based three-dimensional coordinate system.

11. The method of claim 1, whereby in step (b), said extent of change in the saturation of said selected individual color is selected from the group consisting of an increase and a decrease, of intensity of said individual color characterized in a color space featuring a color based three-dimensional coordinate system.

12. The method of claim 1, whereby in step (c) said arithmetic and logical operations are selected from the group consisting of addition, subtraction, multiplication, division, equal to, greater than, less than, absolute value of, and, combinations thereof.

13. The method of claim 1, whereby step (d) is performed following said identifying each said input image pixel, one at a time, of said plurality of said input image pixels, or, is performed following said identifying entire said plurality of said input image pixels, as having said individual color in the digital video input image whose hue or saturation was selected to be independently changed.

14. The method of claim 1, whereby in step (d), for independently controlling the hue of said selected individual color in the real time digital video image, said independent color hue control function is a function of said input image pixel values of said plurality of said input image pixels and of said corresponding selected independent color hue control delta value.

15. The method of claim 1, whereby in step (d), for independently controlling the saturation of said selected individual color in the real time digital video image, said independent color saturation control function is a function of said input image pixel values of said plurality of said input image pixels and of said corresponding selected independent color saturation control delta value.

16. The method of claim 1, whereby step (e) is performed following said determining said output image pixel values for each said input image pixel, one at a time, of said plurality of said input image pixels, or, is performed following said determining said output image pixel values for

entire said plurality of said input image pixels, identified as having said individual color in the real time digital video input image whose hue or saturation was selected to be independently changed.

17. A system for independently controlling hue or saturation of individual colors in a real time digital video image, comprising:

- (a) a real time digital video image display device displaying the real time digital video image featuring input image pixels;
- (b) a master control device in operative electronic communication with and controlling said real time digital video image display device; and
- (c) a viewer of said real time digital video image display device operating said master control device for selecting to independently change the hue or the saturation of an individual color in the real time digital video input image, by selecting an independent color hue control delta value or an independent color saturation control delta value featured on said master control device, respectively, wherein said independent color hue control delta value represents an extent of change in the hue of said selected individual color and wherein said independent color saturation control delta value represents an extent of change in the saturation of said selected individual color, whereby said real time digital video image display device in said operative electronic communication with said master control device performs steps including:
 - (i) identifying a plurality of said input image pixels having said selected individual color in the real time digital video input image with the hue or the saturation selected to be independently changed, by performing arithmetic and logical operations using input image pixel values of each said input image pixel of the real time digital video input image;
 - (ii) determining corresponding output image pixel values for each of said plurality of said input image pixels identified as having said selected individual color in the real time digital video input image with the hue or the saturation selected to be independently changed, by separately evaluating independent color hue control functions or independent color saturation control functions, respectively, using said input image pixel values of said plurality of said input image pixels, and using corresponding said selected independent color hue control delta value or said corresponding selected independent color saturation control delta value, for forming a corresponding plurality of output image pixels having said selected individual color with the hue or the saturation selected to be independently changed; and
 - (iii) displaying a real time digital video output image including said corresponding plurality of said output image pixels having said selected individual color with the hue or the saturation selected to be independently changed in the real time digital video input image, whereby the hue or the saturation of said selected individual color in the real time digital video input image has been changed without affecting the hue or the saturation of any other individual color in the real time digital video input image.

18. The system of claim 17, whereby the real time digital video input image is of a format selected from the group consisting of RGB format, YCrCb format, and, YUV format, whereby the individual colors of one said format can be characterized by the individual colors of a second said format by using appropriate linear transformations between said formats.

19. The system of claim 17, whereby the real time digital video input image features basic colors red, green, and blue, and, complementary colors yellow, cyan, and magenta, in RGB color space, whereby values of said complementary colors are expressed in terms of and evaluated from linear combinations of values of said basic colors.

20. The system of claim 17, whereby the real time digital video input image features basic colors yellow, cyan, and magenta, and, complementary colors red, green, and blue, in YCM color space, whereby values of said complementary colors are expressed in terms of and evaluated from linear combinations of values of said basic colors.

21. The system of claim 17, whereby numerical range of said independent color hue control delta value and numerical range of said independent color saturation control delta value corresponds to an arbitrary interval of integers.

22. The system of claim 17, whereby numerical range of said independent color hue control delta value is an interval between -1 and +1.

23. The system of claim 17, whereby numerical range of said independent color saturation control delta value is an interval between -1 and +1.

24. The system of claim 17, whereby said independent color hue control delta value is completely independent and separate from said independent color saturation control delta value.

25. The system of claim 17, whereby said independent color saturation control delta value is completely independent and separate from said independent color hue control delta value.

26. The system of claim 17, whereby said extent of change in the hue of said selected individual color is selected from the group consisting of a clockwise change and a counterclockwise change, of an angle of said selected individual color towards other individual colors characterized in a color space featuring a color based three-dimensional coordinate system.

27. The system of claim 17, whereby said extent of change in the saturation of said selected individual color is selected from the group consisting of an increase and a decrease, of intensity of said individual color characterized in a color space featuring a color based three-dimensional coordinate system.

28. The system of claim 17, whereby in step (i), said arithmetic and logical operations are selected from the group consisting of addition, subtraction, multiplication, division, equal to, greater than, less than, absolute value of, and, combinations thereof.

29. The system of claim 17, whereby step (ii) is performed following said identifying each said input image pixel, one at a time, of said plurality of said input image pixels, or, is performed following said identifying entire said plurality of said input image pixels, as having said individual color in the digital video input image whose hue or saturation was selected to be independently changed.

30. The system of claim 17, whereby in step (ii), for independently controlling the hue of said selected individual color in the real time digital video image, said independent color hue control function is a function of said input image pixel values of said plurality of said input image pixels and of said corresponding selected independent color hue control delta value.

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31. The system of claim 17, whereby in step (ii), for independently controlling the saturation of said selected individual color in the real time digital video image, said independent color saturation control function is a function of said input image pixel values of said plurality of said input image pixels and of said corresponding selected independent color saturation control delta value.

32. The system of claim 17, whereby step (iii) is performed following said determining said output image pixel

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values for each said input image pixel, one at a time, of said plurality of said input image pixels, or, is performed following said determining said output image pixel values for entire said plurality of said input image pixels, identified as having said individual color in the real time digital video input image whose hue or saturation was selected to be independently changed.

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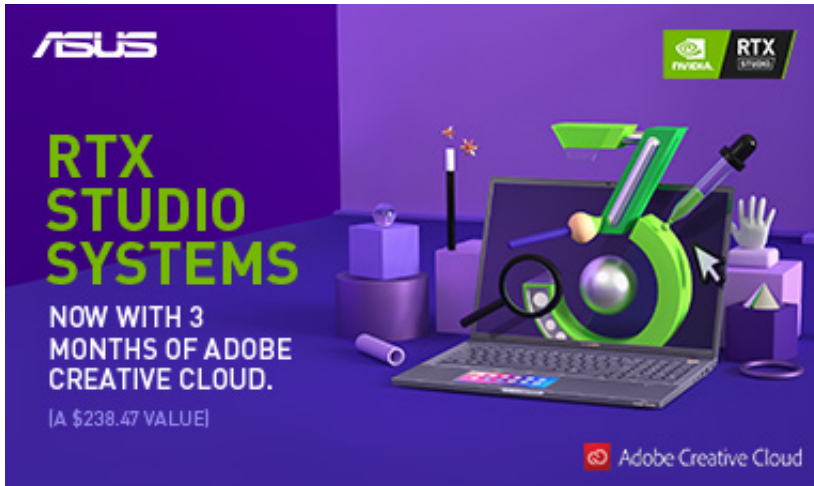
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FAQ

[LCD Monitor] What is 6-axis color independent control ?

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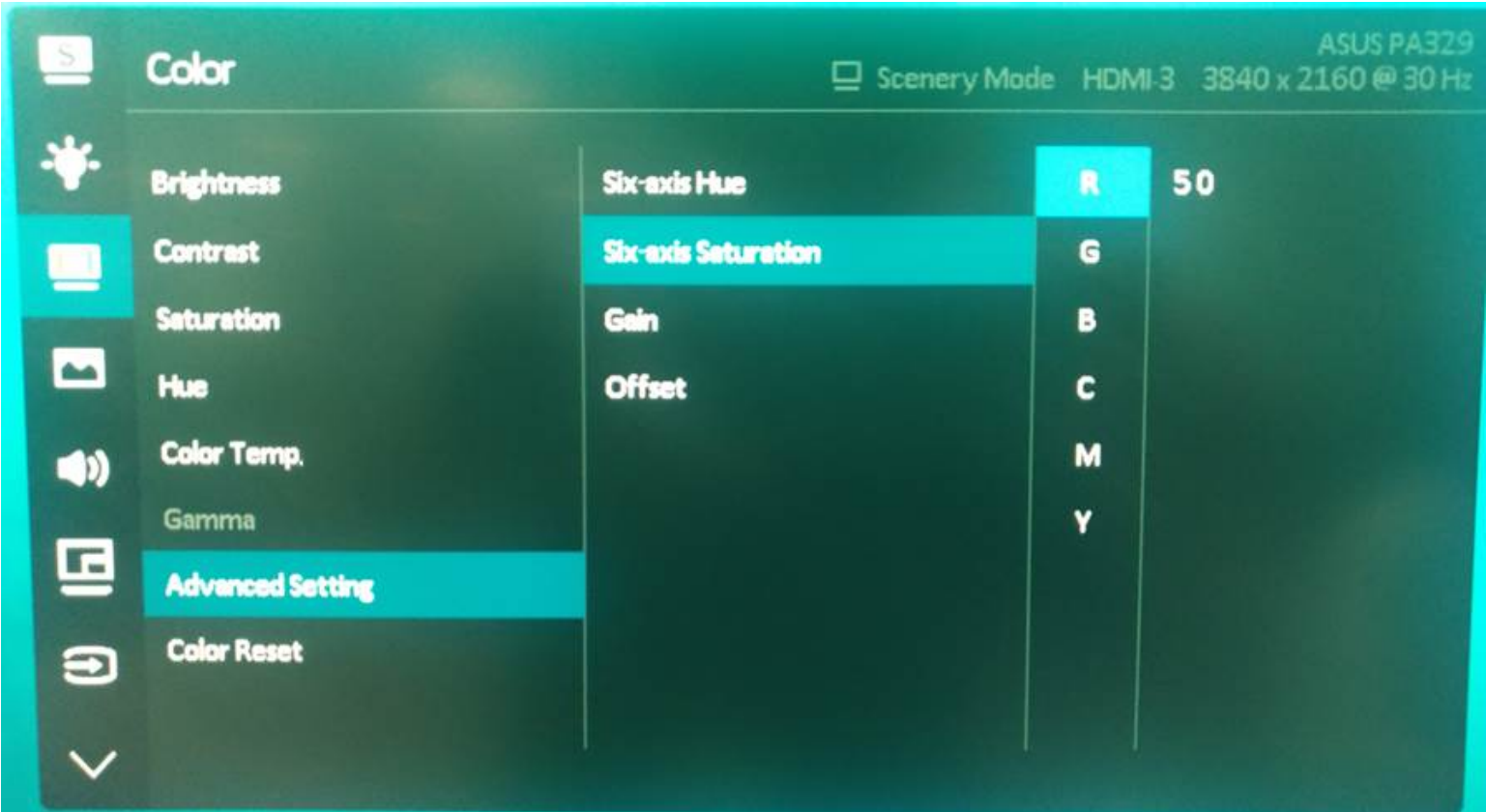
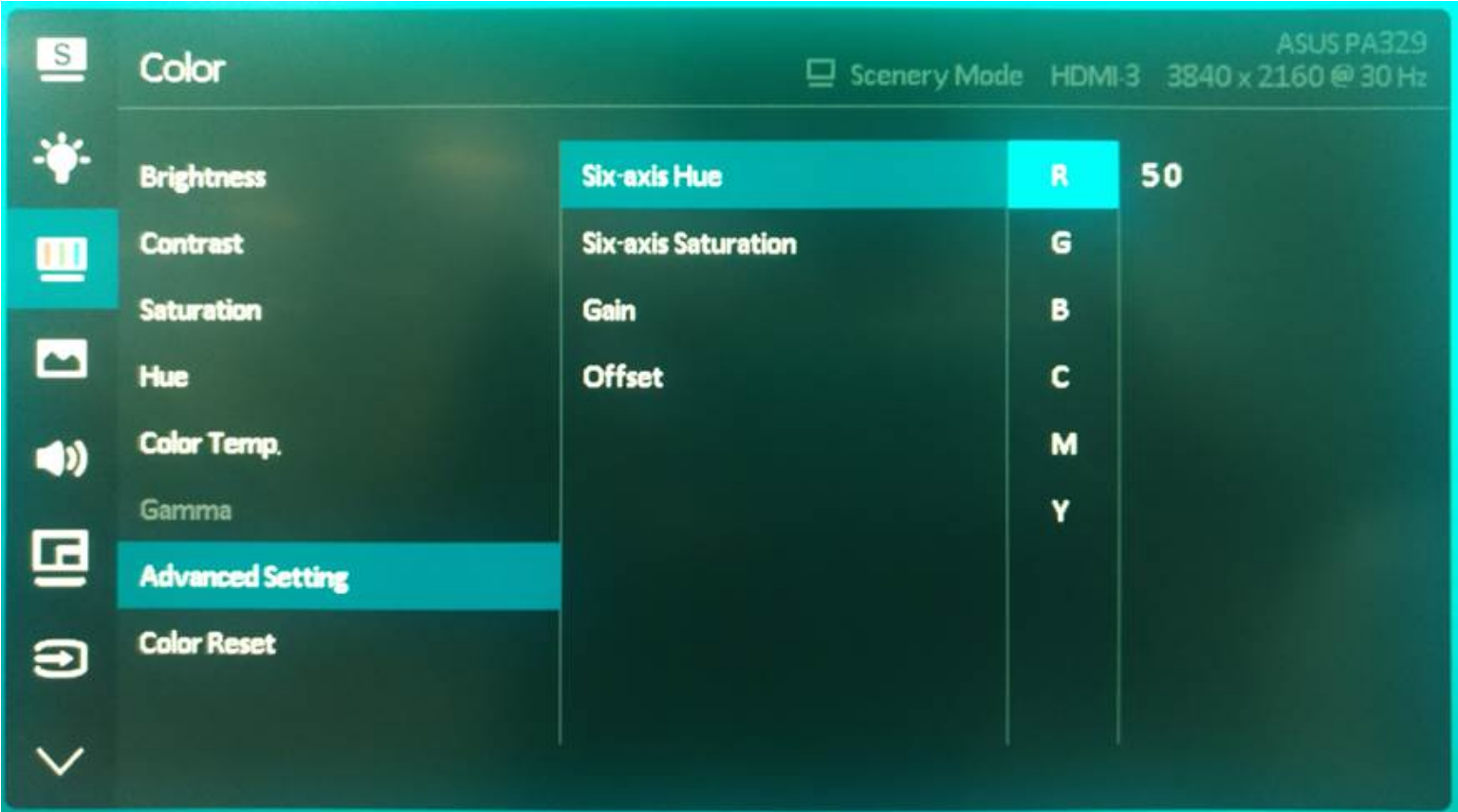
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Product : PA248Q, PA24AC, PA328Q, PA329C, PA329Q, PA32UC, PA32UC-K, PA32UCX, PA32UCX_K, PA34VC, PQ22UC

What is 6-axis color independent control ?

ASUS features an advanced color adjustment so you can individually customize hue and saturation for each axis color under the **Scenery mode** and **Dark mode**.

For example, you can adjust the six colors (red, green, blue, cyan, magenta, and yellow) without affecting the output of other colors.



Category : **LCD Monitor/ Touch Screen/ Display issue**

Type : **Product Knowledge**

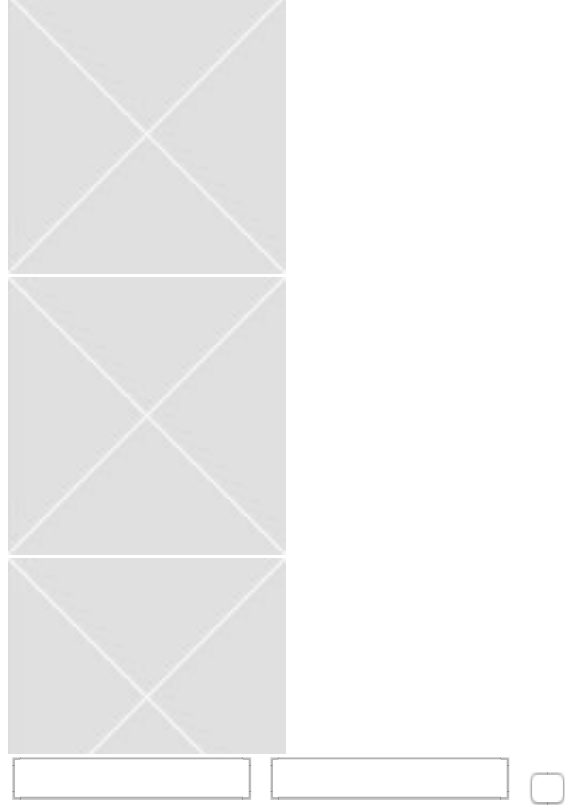
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AMD
X570
AURA

ASUS

* Compared to ASUS previous-gen motherboards
Testing Configuration: CPU: AMD 12-core Ryzen 3900X | DIMM: G.SKILL DDR4 2133 8GB x 2 | HDD: WD 3.5" 500GB | VGA: RTX 2060 | PSU: 1200W | OS: Windows 10, 64-bit
Testing Method: Running Prime 95 small FFTs for 40min with water-cooling

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FAQ

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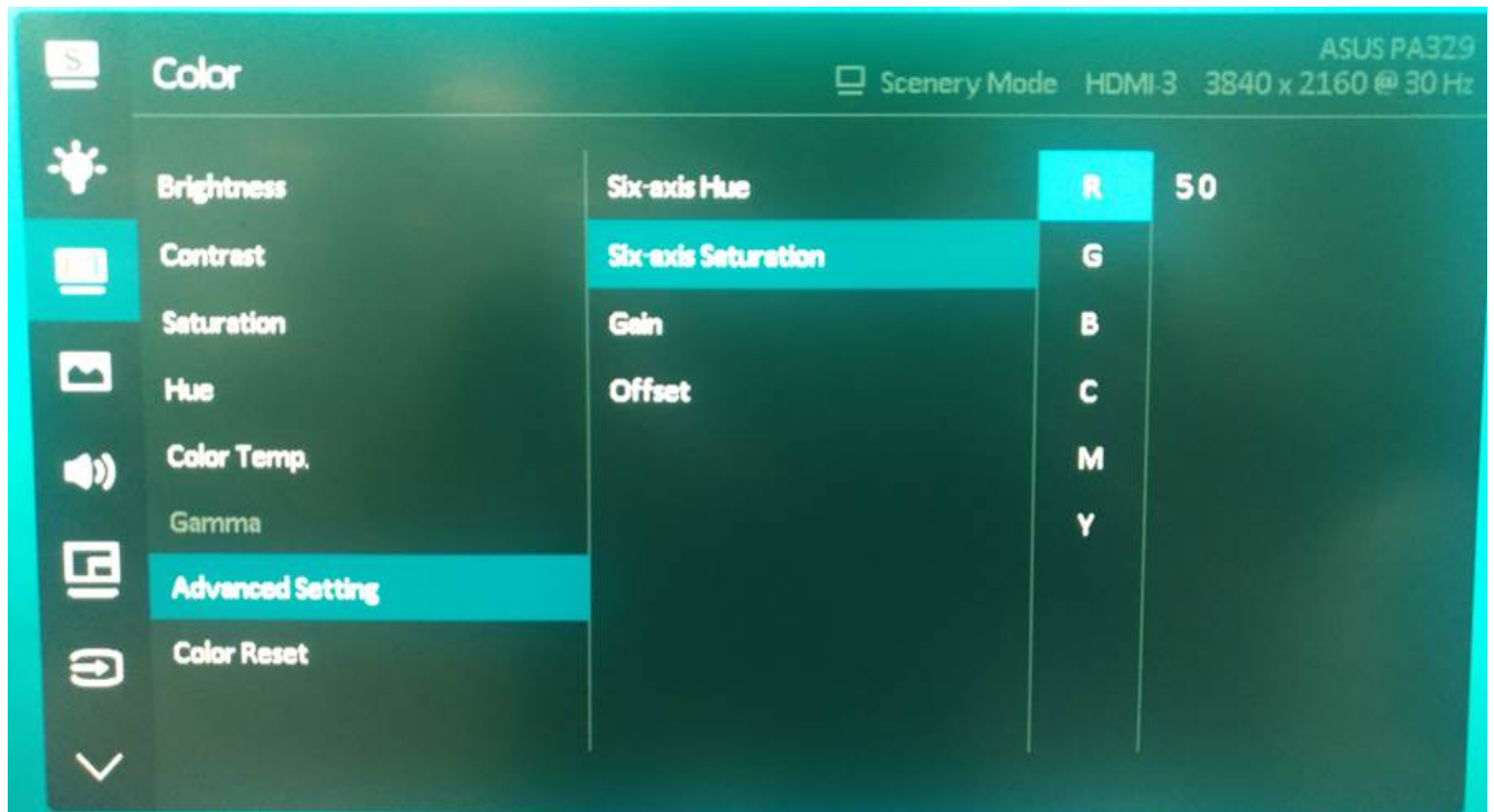
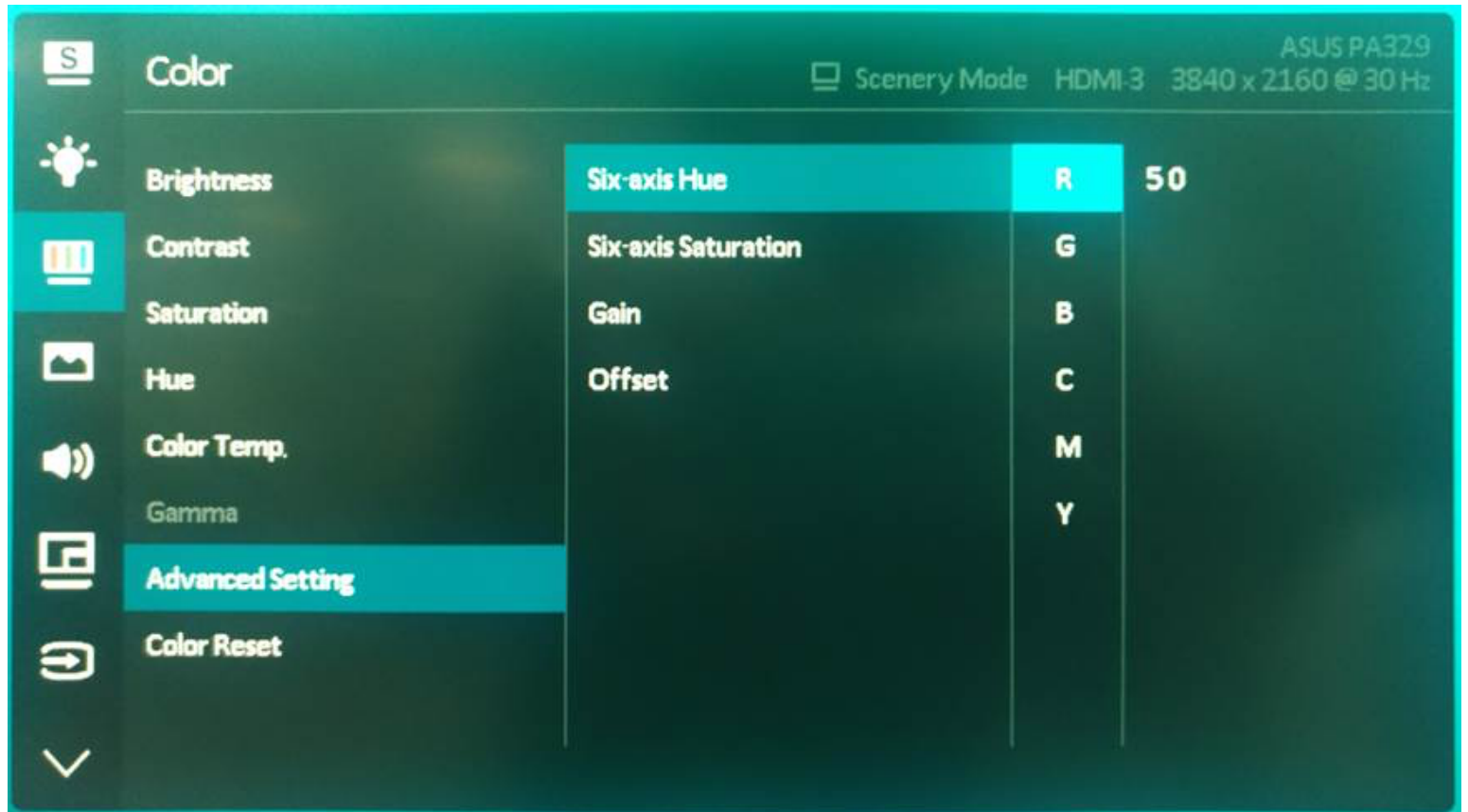
OPEN ON YOUR SMART PHONE

Product : PA248Q, PA24AC, PA328Q, PA329C, PA329Q, PA32UC, PA32UC-K, PA32UCX, PA32UCX_K, PA34VC, PQ22UC

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For example, you can adjust the six colors (red, green, blue, cyan, magenta, and yellow) without affecting the output of other colors.



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Was this information helpful?

YES

NO



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We can help you



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ProArt
Display
PA248QV
Professional
Monitor –
24.1-inch,
16:10,
IPS, WUXGA
(1920 x
1200), 100%
sRGB, 100%
Rec.709,
Color
Accuracy ΔE
< 2, Calman
Verified,
ProArt
Preset,
ProArt
Palette,
Ergonomic
Stand



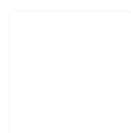
- 24.1-inch 16:10 WUXGA (1920 x 1200) IPS display with frameless design
- International color standard 100% sRGB and 100% Rec. 709 wide color gamut
- Calman Verified with factory pre-calibrated for



excellent color
accuracy ($\Delta E < 2$)

- ASUS exclusive ProArt Preset and ProArt Palette provides several adjustable color parameters and preset modes
- 75Hz refresh rate and Adaptive-Sync technology (48~75Hz) to animated content with fast action and eliminate screen tearing
- Extensive connectivity with DisplayPort, HDMI, D-sub, Audio in, Earphone jack plus four USB 3.0 ports for the most flexibility
- VESA wall-mountable and ergonomic design with tilt, swivel, pivot and height adjustments for a comfortable viewing experience

☐ Compare



ProArt Display PA248QV

Incomparable Color.
Unlimited Creativity.

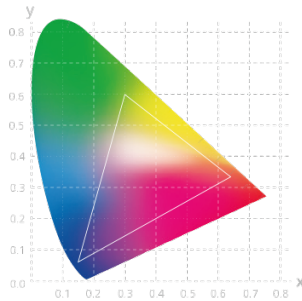


ProArt Display PA248QV is a 24.1-inch monitor designed to satisfy the needs of creative professionals, from photo and video editing to graphic design. ProArt Display PA248QV is factory calibrated and Calman Verified to deliver superb color accuracy ($\Delta E < 2$). It also provides industry-standard 100% sRGB / 100% Rec. 709 color space coverage. With ASUS-exclusive features, such as ProArt Preset and ProArt Palette with six-axis color, black-level and brightness adjustments, PA248QV makes it easy to achieve the exact look you desire quickly, easily and precisely.

Bring out the true
beauty of your
pictures

100%
sRGB

100%
Rec. 709



The ProArt display delivers industry-standard 100% sRGB and 100% Rec. 709 color gamut for rich, vivid reproduction that ensures every detail of your photos is clear and lifelike.

High color
fidelity for
truly
expressive
hues

Revel in pure, expressive hues thanks to accurate, true-to-life color reproduction. ProArt displays achieve $\Delta E < 2$, so your images are accurately reproduced on screen – allowing you to see exactly how your work is going to look when it's finished.

$\Delta E < 2$

True color, right out of box

Color professionals rely on color-accurate displays to ensure that their creations look exactly as intended. ProArt Display PA248QV is factory calibrated and Calman Verified to guarantee industry-leading color accuracy. Every ProArt display undergoes stringent, meticulous testing to ensure smoother color gradation. Consumer of pro, you're assured color-accurate viewing and content-creation experiences.

Quick color-gamut adjustment

ASUS-exclusive ProArt Preset provides multiple modes for quick color-gamut adjustment. Whether you're color grading, video editing or manipulating photos, you can switch and match your needs easily.





Personalized editing experience

ASUS ProArt Palette lets you customize your display via a wide range of parameters, including color hue, temperature and gamma adjustments – all easily accessed via intuitive on-screen menus. There are also two-point grayscale sliders for all six colors, providing greater color adjustment flexibility than many competing monitors. ProArt Palette empowers you to produce quickly and consistently, and makes it easy to keep your color management in check.



ProArt Palette

Rich Connectivity

ProArt Display PA248QV offers rich connectivity with DisplayPort 1.2, HDMI (v1.4), D-Sub ports and a built-in USB hub, so it's easy to hook up to a wide variety of devices and enjoy ultrafast transfer speeds with external storage – catering to every content-creation demand.



Real-size artwork preview

Save time and work smarter with ASUS QuickFit Virtual Scale. This clever feature overlays a grid on the screen that allows to align and preview documents in their actual sizes prior to printing.



Protect your eyes with ASUS Eye Care
technology

ASUS Ultra-Low Blue Light technology

Exclusive ASUS Ultra-Low Blue Light technology protects you from blue-light emissions that may be

harmful to your vision. It offers four blue-light filter settings that are easily accessed through the on-screen menu via the hotkey.



ASUS Flicker-Free technology

ASUS Flicker-Free technology provides a more comfortable viewing experience and work environment by reducing on-screen flicker to minimize eye strain, headaches and eye fatigue when you spend long hours in front of the display.



Versatile comfort with ergonomic stand design

With an ergonomically-designed stand with tilt, swivel, pivot and height adjustments, ProArt displays provide comfortable viewing and usage experiences. The ability to pivot the screen clockwise or counterclockwise 90 degrees for use in portrait mode comes in handy when working with long documents, coding or website browsing. Furthermore, the quick-release stand makes it easy to attach the display via the integrated VESA wall mount – screw-free, so it's done in seconds!



- Products certified by the Federal Communications Commission and Industry Canada will be distributed in the United States and Canada. Please visit the ASUS USA and ASUS Canada websites for information about locally available products.
- All specifications are subject to change without notice. Please check with your supplier for exact offers. Products may not be available in all markets.
- Specifications and features vary by model, and all images are illustrative. Please refer to specification pages for full details.
- PCB color and bundled software versions are subject to change without notice.
- Brand and product names mentioned are trademarks of their respective companies.
- The terms HDMI and HDMI High-Definition Multimedia Interface, and the HDMI Logo are trademarks or registered trademarks of HDMI Licensing Administrator, Inc. in the United States and other countries.
- The actual transfer speed of USB 3.0, 3.1, 3.2, and/or Type-C will vary depending on many factors including the processing speed of the host device, file attributes and other factors related to system configuration and your operating environment.



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Monitors

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ProArt Display PA248QV

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Community



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PATENT LICENSE AND SETTLEMENT AGREEMENT

This PATENT LICENSE AND SETTLEMENT AGREEMENT (this "Agreement") is made and entered into as of the date by which all parties have signed the Agreement (the "Effective Date") by and between Plaintiff Lone Star Technological Innovations, LLC, a limited liability company organized and existing under the laws of the State of Texas, having a principal place of business at 1999 Bryan Street, Suite 900, Dallas, Texas, 75201 ("Plaintiff"), and Acer America Corporation, a corporation organized and existing under the laws of the State of California, having its principal place of business at 333 W San Carlos St, San Jose, CA 95110 and Acer, Inc. Inc., company organized and existing under the laws of Taiwan, ROC, having its principal place of business at 8F, 88, Sec.1, Xintai 5th Road, Xizhi, New Taipei City 221, Taiwan, ROC (hereinafter referred to collectively as "Defendant"). Plaintiff and Defendant are individually referred to herein as a "Party," and collectively as the "Parties."

WITNESSETH

WHEREAS, Plaintiff has filed an action against Defendant, for patent infringement in an action styled *Lone Star Technological Innovations, LLC v. Acer, Inc, and Acer America Corporation*, Case No. 6:15-cv-973, related to Plaintiff's U.S. Patent Nos. 6,724,435 and 6,122,012 ("Patents-In-Suit") pending in the United States District Court for the Eastern District of Texas (the "Litigation").

WHEREAS Defendant denies infringement and alleges that the Patents-in-suit are invalid and unenforceable;

WHEREAS, this Agreement has not been negotiated under the "Hypothetical Negotiation" standard and the parties have not negotiated and agree this settlement does not represent a reasonable royalty as this settlement is an agreement between the parties to resolve a commercial dispute;

WHEREAS, the Parties agree that they are entering this Agreement for the primary purpose of avoiding the cost and expense of the Litigation;

WHEREAS, Defendant represented during the negotiations for this Agreement that Defendant's sales of accused products are de minimis and limited to approximately 464,484 products sold in the United States; and

NOW, THEREFORE, in consideration of the above promises and mutual covenants hereinafter contained, the parties agree as follows:

1. DEFINITIONS

As used in this Agreement, the following terms shall have the following meanings:

"Affiliate" means, with respect to a party, any current and future (i) grandparent, parent, sister, subsidiary of a party or (ii) any individual, trust, corporation, partnership, joint venture, limited liability company, association, unincorporated organization or other legal entity; in each case that is controlling the party, controlled by the party, or is under common control with such party. For purposes of this Agreement, "control" shall exclusively mean the ownership, directly or indirectly, of fifty percent (50%) or more of the outstanding voting shares of such an entity, or an ownership right representing more than 50% of the rights to make decisions for such an entity. Notwithstanding the foregoing, with respect to Defendant, the term "Affiliates" excludes any Person that is a party to a pending patent infringement claim or lawsuit filed by Plaintiff with respect to the Licensed Patents prior to controlling, becoming controlled by, or becoming under common control with Defendant.

"Licensed Products" means the products and services of or provided by Defendants and/or its Affiliates which would constitute, but for the license granted to Defendant herein, an infringement, as defined by 35 U.S.C 271 of any claims of any of the Licensed Patents.

"Patents" mean, (i) all classes and/or types of patents, including utility patents, utility models, design patents, invention certificates, reexaminations, reissues, extensions and renewals anywhere in the world; and (ii) all applications

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(including provisional and nonprovisional applications), continuations, divisionals, continuations-in-part, and rights to inventions for which applications may be filed, for these classes and/or types of patents.

“Person” means any individual, corporation, partnership, joint venture, trust, unincorporated organization, or other legal entity.

“Licensed Patents” means the United States Patents and Foreign Patents listed in Exhibit A of this Agreement.

“Third Party” means any person or entity other than a party (including such party’s Affiliates) to this Agreement.

2. LICENSE, RELEASES AND COVENANTS

- 2.1. License. Subject to the payment provided under Section 3 and compliance by Defendant and its Affiliates with the terms and conditions of this Agreement, Plaintiff, on behalf of itself, its Affiliates, and their respective employees, hereby grants to Defendant and its Affiliates a fully paid-up, non-exclusive, non-sublicensable, non-transferable (to other Third Party than the Affiliate of Defendants), worldwide license to (i) make, have made, use, import, export, distribute, sell, offer for sale, lease, develop and advertise under the Licensed Patents solely with respect to the Licensed Products only to the extent that it relates to the Licensed Products; (ii) make, have made, use and import machines, tools, materials and other instrumentalities, insofar as such machines, tools, materials and other instrumentalities are required for the development, manufacture, testing or repair of Licensed Products which are or have been made, offered for sale, used, leased, owned, sold, exported or imported by Defendant; and (iii) convey to any customer of Defendant and/or its Affiliates the rights to use, offer for sale, lease, import, export, resell, transfer and otherwise dispose of such Licensed Products as sold, leased, transferred or otherwise disposed of by Defendant and/or its Affiliates. For the avoidance of doubt, this Section 2.1 shall not cover any Third Party products or services, except that the license grant set forth in this Section 2.1 shall include (i) Defendant’s and its Affiliates’ distributors, resellers, end users, and customers with respect to the Licensed Products.
- 2.2. Plaintiff Release of Defendant. Subject to the payment provided under Section 3 and the compliance by Defendant and its Affiliates with the terms and conditions of this Agreement, Plaintiff, on behalf of itself, its Affiliates, and their respective, attorneys, insurers, agents, officers, directors and employees (“Plaintiff Releasing Party”) hereby, fully, irrevocably and forever releases, acquits, and discharges Defendant and its Affiliates, and their respective officers, directors, managers, members, employees, agents, experts, consultants attorneys, customers, suppliers and contract manufacturers (“Defendant Released Party”) from any and all claims, counterclaims, demands, losses, costs, damages, debts, liabilities, obligations and causes of action (regardless of whether they are now known or unknown, suspected or unsuspected) that the Plaintiff Releasing Party may have on account of the Defendant Released Party’s acts related to: (i) any act (including but not limited to making, having made, keeping, using, leasing, selling, offering to sell, importing, exporting, transferring, or otherwise disposing) of past, present, or future infringement, direct, contributory, or by inducement of any of the Licensed Patents solely with respect to the Licensed Products; (ii) the claims and counterclaims asserted in, and the conduct of, the Litigation; and (iii) the conduct of settlement negotiations occurring before the Effective Date (except for representations and obligations expressly included in this Agreement).
- 2.3. Plaintiff Covenant Not to Sue Defendant. Subject to the payment provided under Section 3 and compliance by Defendant and its Affiliates with the terms and conditions of this Agreement, Plaintiff, on behalf of itself and its Affiliates covenants not to sue Defendant, its Affiliates, and their respective customers, suppliers and contract manufacturers for infringement of the Licensed Patents solely with respect to the Licensed Products.
- 2.4. Defendant Release of Plaintiff. Subject to Plaintiff’s compliance with the terms and conditions of this Agreement, Defendant, on behalf of the Defendant Released Party releases Plaintiff, its Affiliates and the Plaintiff Releasing Party from any and all claims, counterclaims, demands, losses, costs, damages, debts, liabilities, obligations and causes of action (regardless of whether they are now known or unknown, suspected or unsuspected) that the Defendant Released Party may have on account of the: (i) the Licensed Patents; (ii) the claims and counterclaims asserted or which could have been asserted in, and the conduct of, the Litigation;

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- and (iii) the conduct of settlement negotiations occurring before the Effective Date (except for representations and obligations expressly included in this Agreement).
- 2.5. Defendant Covenant Not to Sue Plaintiff. Subject to Plaintiff's compliance with the terms and conditions of this Agreement, Defendant on behalf of itself and its Affiliates, covenants not to sue Plaintiff or its Affiliates for any claims related to the Licensed Patents. Defendant further covenants, represents and warrants that it shall not contest or assist in the contest in any forum, including Federal Courts, whether under 28 U.S.C. §§ 2201-2202 or not, the United States Patent and Trademark Office, and/or the International Trade Commission, that the Licensed Patents are valid and enforceable. Defendant reserves the right to contest the validity and enforceability of the Licensed Patents solely to the extent a claim of infringement under the Licensed Patents is brought against Defendant with respect to the Licensed Products. It is hereby agreed that complying with the requirements of law to provide information served by Third Party (e.g. subpoena for document production) shall not be deemed a violation of this Section 2.5.
- 2.6. No Other Rights / No Exhaustion. No rights or covenants are granted under any patents except as expressly provided herein, whether by implication, estoppel or otherwise. Except as otherwise expressly granted in this Agreement, no right to grant covenants, rights, sublicenses or to become a foundry for Third Parties is granted under this Agreement.
- 2.7. Releases. The releases in this Agreement include an express, informed, knowing and voluntary waiver and relinquishment to the fullest extent permitted by law. In this connection, the parties acknowledge that they may have sustained damages, losses, costs or expenses which are presently unknown and unsuspected and that such damages, losses, costs or expenses as may have been sustained may give rise to additional damages, losses, costs or expenses in the future. The parties hereto further acknowledge that they have negotiated this Agreement taking into account presently unsuspected and unknown claims, counterclaims, causes of action, damages, losses, costs and expenses, and the parties hereto voluntarily and with full knowledge of its significance, expressly waive and relinquish any and all rights they may have under any state or federal statute, rule or common law principle, in law or equity, relating to limitations on general releases. The parties voluntarily and with full knowledge of its significance, expressly waive and relinquish any and all rights they may have under any state or federal statute, rule or common law principle, in law or equity, relating to limitations on releases. Specifically, each party hereby expressly waives any rights it may have under California Civil Code Section 1542 (or any other similar law in any jurisdiction) which provides that: "A general release does not extend to claims which the creditor does not know or suspect to exist in his favor at the time of executing the release, which if known by him must have materially affected his settlement with the debtor."
- 2.8. Termination of Litigation. No later than five (5) business days after receipt of Payment by Plaintiff, set forth in section 3.1, or such time as required by the Court, the Parties shall request dismissal of the Litigation with prejudice by filing the form of dismissal attached hereto as Schedule B, or by such other procedure as agreed to between the Parties or which may be reasonably necessary to dismiss the Litigation with prejudice.
3. ADDITIONAL CONSIDERATION
- 3.1. Payment. In consideration of the license, release and covenant granted by Plaintiff and the dismissal by Plaintiff of Litigation hereunder in addition to all other consideration provided for in this Agreement, Defendant Acer Inc. agrees to pay the Settlement and License Amount by expending a total of \$281,250 USD, of which Acer Inc. will withhold 20 percent for Taiwanese withholding taxes. The total amount received by Lonestar after the withholding (80% of \$281,250) is the Settlement and License Amount. Defendant shall cause the Settlement and License Amount to be paid no later than thirty (30) days as of the Effective Date, by wire transfer to the following account:

Banie & Ishimoto LLP Wells Fargo Trust Account

Account Number: [REDACTED]

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Routing Numbers

Direct Deposits: [REDACTED]

Wire Transfers – Domestic: [REDACTED]

Swift Code for Transfers: WFBIUS6S

- 3.2. Taxes / Costs. The payment required by this Agreement shall not be reduced by Defendant for any taxes, levies, imposts, customs, duties, fees or similar charges imposed by any governmental authority of any nature including sales or use tax, excise tax, stamp tax or duty, any withholding or back up withholding tax and value added tax. Each Party agrees to bear and be responsible for the payment of any taxes (including income taxes), levies, imposts, customs, duties, fees and charges that may be levied or assessed on it in connection with this Agreement. Defendant will not deduct or withhold any amounts from the payment to Licensor required under Section 3.1 of this Agreement. Defendant agrees to provide foreign tax withholding documents, if any, within 15 days of making payment under Section 3.1 of this Agreement. The parties agree that they shall bear their own costs and attorneys' fees relating to or arising from the Litigation and to the negotiation of this Agreement. Specifically, Plaintiff will be responsible for any taxes to which it is subject as a result of the payment made by Defendant to Plaintiff in accordance with Section 3.1 under this Agreement.
- 3.3. Stand Still of the Litigation and Dismissal. Immediately following the execution of this Agreement, the Parties shall jointly advise the court presiding over the Litigation on a confidential basis that such action is pending settlement and that, subject to the terms and satisfaction of conditions of a confidential Agreement between the Parties and payment of the monetary consideration under Section 3.1, a motion to dismiss will be filed. The Parties shall also request, if applicable, that all outstanding deadlines in any procedural schedule be stayed or suspended pending dismissal. Within five (5) court days after the payment of the consideration to Plaintiff under this Section 3, the parties shall cause their respective counsel to execute and file the stipulated motion in the form set forth in Exhibit B dismissing with prejudice all claims and counterclaims between the parties in the Litigation. The parties shall promptly proceed with any and all additional procedures needed to dismiss with prejudice the Litigation. The parties acknowledge and agree that this Agreement is enforceable according to its terms with respect to final dismissal with prejudice of all claims and counterclaims in the Litigation.
- 3.4. The amount in Section 3.1 shall be nonrefundable under any and all circumstances, including but not limited to the Licensed Patents being held invalid or unenforceable.

4. TERM AND TERMINATION

- 4.1. Term. The term of this Agreement shall commence upon the Effective Date and shall continue until the expiration of the last-to-expire of the Licensed Patents, unless earlier terminated by Plaintiff as set forth below.
- 4.2. Termination. If and only if Defendant or any Defendant Affiliate or any valid assignee of Defendant (subject to the provisions of Section 5 below) breaches this Agreement, and does not cure such breach within thirty (30) days after written notice thereof from Plaintiff (such notice being required only if Plaintiff reasonably believes such breach is capable of being cured), the license, releases and covenants granted by Section 2 of this Agreement shall automatically terminate after such thirty (30) day period so long as the breach remains uncured.
- 4.3. Survival. In the event of termination pursuant to Section 4.2, the license, releases and covenants granted to Defendant and its Affiliates hereunder shall terminate as of the date that such termination takes effect and the non-breaching party shall retain its remedies for such breach. The provisions of Sections 1, 2 (2 only as applicable to the non-breaching party), 3, 4, 5 and 6 will survive any termination of this Agreement.

5. ASSIGNMENT

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5.1. No Assignment. Except as set forth below, neither party may assign (by contract, operation of law or otherwise) its rights under this Agreement without the prior written consent of the other and any attempt to assign without such permission will be void..

(a) Permitted Assignment by Defendant. Defendant may assign its rights under this Agreement, in whole or in part, without Plaintiff's prior written consent: (i) as part of a merger (in which it is not the surviving entity) with, or sale of all or substantially all of its assets or shares to, a Third Party acquirer (an "Acquirer"), provided that (a) the Acquirer is not a party to a written communication by Plaintiff asserting a patent infringement claim or lawsuit filed by Plaintiff with respect to one or more of the Licensed Patents and pending at the time Defendant conducts such sale, transfer or spin-off; and (b) the rights of Defendant hereunder so assigned, including any licenses, releases and covenants not to sue only extend to (aa) Licensed Products existing as of the date of such sale, transfer or spin-off; or (bb) any improvement, upgrades updates to (aa); or (cc) Licensed Products to be made, had made, sold, offered for sale according to the product road map of Defendant, which product road map was in existence prior to the assignment, as supported by Defendant's written evidence; and will not extend to any other products, services or activities, including those of the Acquirer or any of its Affiliates. In addition to the foregoing, all releases and covenants of Defendant and its Affiliates contained herein shall run with the rights of Defendant being assigned or transferred and shall be binding on any successors-in-interest, transferees, or assigns thereof. Defendant shall not assign or otherwise transfer any right hereunder to any other party unless (i) such sale or assignment is subject to all of the terms and conditions of this Agreement, and (ii) such other party executes an agreement agreeing to be bound by all of the terms and conditions of this Agreement with respect to the rights being transferred or assigned.

(b) Permitted Assignment by Plaintiff. Notwithstanding the provisions of Section 5.1, Plaintiff shall be permitted to assign this Agreement to an Affiliate.

5.2. All rights, releases, licenses and covenants contained herein shall run with the Licensed Patents and shall be binding on any successors-in-interest, assigns thereof, or exclusive licensees. Plaintiff and its Affiliates shall not assign, sell, exclusively license or otherwise transfer or grant any ownership right or right to enforce or recover under any of Licensed Patents to any other party without the same being subject to the rights, covenants, licenses and releases provided by Plaintiff or Plaintiff's Affiliate under this Agreement. Subject to the foregoing, this Agreement shall be binding upon and inure to the benefit of the Parties and their permitted successors and assigns.

6. MISCELLANEOUS PROVISIONS

6.1. Representations:

6.1.1. Plaintiff Representations: Plaintiff represents and warrants, with respect to the currently existing Licensed Patents only, as of the Effective Date that: (i) Plaintiff, on behalf of itself and its Affiliates, owns and/or controls the Licensed Patents, and has the sufficient right, title and interest to grant the license, releases and covenants with respect to the Licensed Patents of the full scope set forth herein; (ii) it has not assigned or otherwise transferred to any other Person any rights to the Licensed Patents that would prevent Plaintiff from entering into this Agreement; (iii) the person executing this Agreement on behalf of Plaintiff has the full right and authority to enter into this Agreement on Plaintiff's behalf and Plaintiff has the authority to enter into this Agreement; and (iv) Plaintiff is a corporation in good standing under the laws of the state of Texas. Plaintiff further represents and warrants that it understands that it is has exclusively negotiated and is contracting with Defendant, and acknowledges it is not contracting (directly or indirectly, by any legal theory or otherwise) with any other Person or any Third Party and no Person other than Plaintiff and Defendant are parties to this Agreement (directly or indirectly, by implication or under any legal theory or otherwise). Plaintiff further represents and warrants that the Licensed Patents are a complete and full list of Patents owned by Plaintiff as of the Effective Date.

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- 6.1.2. Defendant Representations: Defendant represents and warrants as of the Effective Date that: (i) Defendant has the right to grant the releases and covenants of the full scope set forth herein and (ii) the person executing this Agreement on behalf of Defendant has the full right and authority to enter into this Agreement on Defendant's behalf. Defendant further represents and warrants that it understands that it is has exclusively negotiated and is contracting with Plaintiff, and acknowledges it is not contracting (directly or indirectly, by any legal theory or otherwise) with any other Person or any Third Party and no Person other than Plaintiff and Defendant are parties to this Agreement (directly or indirectly, by implication or under any legal theory or otherwise).
- 6.1.3. No Warranties. Unless otherwise expressly stated in this Agreement, nothing contained in this Agreement shall be construed as: (i) a warranty or representation by either party that any manufacture, sale, use or other disposition of products by the other party has been or will be free from infringement of any patents; (ii) an agreement by either party to bring or prosecute actions or suits against third parties for infringement, or conferring any right to the other party to bring or prosecute actions or suits against third parties for infringement; (iii) conferring any right to the other party to use in advertising, publicity, or otherwise, any trademark, trade name or names of either party, or any contraction, abbreviation or simulation thereof without the prior written consent of the other party; or (iv) conferring by implication, estoppel or otherwise, upon either party, any right (including a license) under other patents except for the rights expressly granted hereunder.
- 6.1.4. CONSEQUENTIAL DAMAGES. IN NO EVENT SHALL EITHER PARTY BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND, INCLUDING BUT NOT LIMITED TO, LOSS OF PROFITS OR DAMAGES TO A PARTY'S BUSINESS REPUTATION HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN AN ACTION FOR CONTRACT, INFRINGEMENT, STRICT LIABILITY OR TORT (INCLUDING NEGLIGENCE) OR OTHERWISE, WHETHER OR NOT A PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND NOTWITHSTANDING THE FAILURE OF ESSENTIAL PURPOSE OF ANY REMEDY.
- 6.2. Confidentiality. From and after the Effective Date, neither party shall disclose the terms of this Agreement except:
- 6.2.1. with the prior written consent of the other party;
- 6.2.2. to any governmental body having jurisdiction and specifically requiring such disclosure;
- 6.2.3. in response to a valid subpoena or as otherwise may be required by law;
- 6.2.4. for the purposes of disclosure in connection with the Securities and Exchange Act of 1934, as amended, the Securities Act of 1933, as amended, and any other reports filed with the Securities and Exchange Commission, or any other filings, reports or disclosures that may be required under applicable laws or regulations;
- 6.2.5. to a party's accountants, legal counsel, tax advisors and other financial and legal advisors, subject to obligations of confidentiality and/or privilege at least as stringent as those contained herein;
- 6.2.6. as required during the course of litigation and subject to protective order; provided however, that any production under a protective order would be protected under an "Attorneys Eyes Only" or higher confidentiality designation; or
- 6.2.7. with obligations of confidentiality at least as stringent as those contained herein, to a counterparty in connection with a proposed merger, acquisition, financing or similar transaction and/or in order to comply with the provisions of Section 3.4 above, provided that in such circumstances only a legal brief will be given;

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provided, however, that prior to any such disclosure pursuant to paragraphs 6.2.2, 6.2.3, 6.2.4 and 6.2.6 hereof, the party seeking disclosure shall promptly notify the other party and take all reasonable actions in an effort to minimize the nature and extent of such disclosure. In furtherance hereof, Defendant will direct its counsel to promptly return to Plaintiff counsel any documents provided to Defendant or its counsel by Plaintiff or its counsel.

- 6.3. Notices. All notices required or permitted to be given hereunder shall be in writing and shall be delivered by hand, or, if dispatched by prepaid air courier, with package tracing capabilities or by registered or certified airmail, postage prepaid, addressed as follows:

If to Plaintiff:

John Lee
Banie & Ishimoto LLP
3705 Have Ave. #137
Menlo Park, CA 94025

If to Defendant:

Acer Incorporated

9F, 88, Sec.1, Xintai 5th Rd.

Xizhi, New Taipei City 221

Taiwan, R.O.C.

Fax +886.2.86911009

Attention: Head of Global License/Litigation Team

Such notices shall be deemed to have been served when received by addressee. Either party may give written notice of a change of address and, after notice of such change has been received, any notice or request shall thereafter be given to such party as above provided at such changed address.

- 6.4. Publicity. Neither party will issue a press release or any other announcement regarding this Agreement or the relationship contemplated herein unless both parties provide prior consent in writing. The parties shall direct their representatives not to make any disclosures of the terms of this Agreement. Notwithstanding the foregoing and Section 6.2 above, (i) upon inquiry either party may state that Plaintiff and Defendant have entered into a patents in suit settlement agreement and (ii) Plaintiff may make the following statements: Acer, Inc. and Acer America Corporation are licensed to certain Lone Star Technological Innovations, LLC patents.”
- 6.5. Governing Law / Jurisdiction. This Agreement and matters connected with the performance thereof shall be construed, interpreted, applied and governed in all respects in accordance with the laws of the United States of America and the State of Texas, without reference to conflict of laws principles. Plaintiff and Defendant agree (a) that all disputes and litigation regarding this Agreement, its construction and matters connected with its performance be subject to the exclusive jurisdiction of the state and federal courts in the Eastern District of Texas, located in Tyler, Texas (the “Court”), and (b) to submit any disputes, matters of interpretation, or enforcement actions arising with respect to the subject matter of this Agreement exclusively to the Court. The parties hereby waive any challenge to the jurisdiction or venue of the Court over these matters.

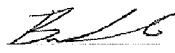
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- 6.6. Sophisticated Parties Represented by Counsel. The parties each acknowledge, accept, warrant and represent that (i) they are sophisticated parties represented at all relevant times during the negotiation and execution of this Agreement by counsel of their choice, and that they have executed this Agreement with the consent and on the advice of such independent legal counsel, and (ii) they and their counsel have determined through independent investigation and robust, arm's-length negotiation that the terms of this Agreement shall exclusively embody and govern the subject matter of this Agreement.
- 6.7. Bankruptcy. Each party irrevocably waives all arguments and defenses arising under 11 U.S.C. 365(c)(1) or successor provisions to the effect that applicable law excuses the party, other than the debtor, from accepting performance from or rendering performance to an entity other than the debtor or debtor in possession as a basis for opposing assumption of the Agreements by the other party in a case under Chapter 11 of the Bankruptcy Code to the extent that such consent is required under 11 U.S.C. § 365(c)(1) or any successor statute. Any change of control resulting from any such bankruptcy proceeding shall remain subject to Section 5 above.
- 6.8. Severability. If any provision of this Agreement is held to be illegal or unenforceable, such provision shall be limited or eliminated to the minimum extent necessary so that the remainder of this Agreement will continue in full force and effect and be enforceable. The parties agree to negotiate in good faith and to enforce a substitute provision for any invalid or unenforceable provision that most nearly achieves the intent of such provision.
- 6.9. Entire Agreement. The parties acknowledge, accept, warrant and represent that (i) this is an enforceable agreement; (ii) this Agreement embodies the entire and only understanding of each of them with respect to the subject matter of the Agreement, and merges, supersedes and cancels all previous representations, warranties, assurances, conditions, definitions, understandings or any other statement, express, implied, or arising by operation of law, whether oral or written, whether by omission or commission between and among them with respect to the subject matter of the Agreement; (iii) no oral explanation or oral information by either party hereto shall alter the meaning or interpretation of this Agreement; (iv) the terms and conditions of this Agreement may be altered, modified, changed or amended only by a written agreement executed by duly authorized representatives of Plaintiff and Defendant, (v) the language of this Agreement has been approved by counsel for each of them, and shall be construed as a whole according to its fair meaning, and (vi) none of the them (nor their respective counsel) shall be deemed to be the draftsman of this Agreement in any action which may hereafter arise with respect to the Agreement.
- 6.10. Modification; Waiver. No modification or amendment to this Agreement, nor any waiver of any rights, will be effective unless assented to in writing by the party to be charged, and the waiver of any breach or default will not constitute a waiver of any other right hereunder or any subsequent breach or default.
- 6.11. Construction; Language. Any rule of construction to the effect that ambiguities are to be resolved against the drafting party will not be applied in the construction or interpretation of this Agreement. As used in this Agreement, the words "include" and "including" and variations thereof, will not be deemed to be terms of limitation, but rather will be deemed to be followed by the words "without limitation." The headings in this Agreement will not be referred to in connection with the construction or interpretation of this Agreement. This Agreement is in the English language only, which language shall be controlling in all respects, and all notices under this Agreement shall be in the English language.
- 6.12. Counterparts. This Agreement may be executed in counterparts or duplicate originals, both of which shall be regarded as one and the same instrument, and which shall be the official and governing version in the interpretation of this Agreement. This Agreement may be executed by facsimile signatures or other electronic means and such signatures shall be deemed to bind each party as if they were original signatures.

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IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be signed below by their respective duly authorized officers.


Lone Star Technological Innovations, LLC

By: 

Name: Bradley D. Liddle

Title: General Counsel

Acer Inc.

By: 

Name: Jason Chen

Title: Corporate President



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EXHIBIT A

United States Patent No. 6,122,012
United States Patent No. 6,191,827
United States Patent No. 6,178,272
United States Patent No. 6,301,619
United States Patent No. 6,724,435
United States Patent No. 7,577,291
United States Patent No. 7,391,416
United States Patent No. 7,512,269
CA 2363727
CA 2365629
CN 134334
CN 101233539
DE 60042111
EP 1157353
EP 1157565
EP 1163797
EP 1428395
EP 1147658
EP 1157340
IL145195
IL 145196
JP 4351394
JP 4489961
JP 2000-590384
JP 2000-602940
JP 4452498
JP 2002538738
JP 2003523106
KR 1020010113722
KR 1020010114217
NZ 513874
SG 84092
TWI 319167
WO WO/2003/060623
WO WO/2003/015391
WO WO/2000/038422
WO WO/2000/046740
WO WO/2000/052938
WO WO/2000/052587
WO WO/2000/033564
WO WO/2007/019265

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EXHIBIT B

STIPULATED MOTION FOR DISMISSAL WITH PREJUDICE

The Plaintiff, Lone Star Technological Innovations, LLC and defendants Acer, Inc. and Acer America Corporation pursuant to Fed. R. Civ. P. 41(a)(2) and (c), hereby move for an order dismissing all claims and counterclaims in this action WITH PREJUDICE, subject to the terms of that certain agreement entitled "**PATENT LICENSE AND SETTLEMENT AGREEMENT**" and dated December __, 2016, with each party to bear its own costs, expenses and attorneys' fees.

ORDER OF DISMISSAL WITH PREJUDICE

CAME ON THIS DAY for consideration of the Stipulated Motion for Dismissal With Prejudice of all claims and counterclaims asserted between plaintiff, Lone Star Technological Innovations, LLC, and defendants, Acer, Inc. and Acer America Corporation, in this case, and the Court being of the opinion that said motion should be GRANTED, it is hereby

ORDERED, ADJUDGED AND DECREED that all claims and counterclaims asserted in this suit between plaintiff, Lone Star Technological Innovations, LLC, and defendants Acer, Inc. and Acer America Corporation, are hereby dismissed with prejudice, subject to the terms of that certain agreement entitled "**PATENT LICENSE AND SETTLEMENT AGREEMENT**" and dated December __, 2016.

It is further ORDERED that all attorneys' fees and costs are to be borne by the party that incurred them.

PATENT LICENSE AND SETTLEMENT AGREEMENT

This PATENT LICENSE AND SETTLEMENT AGREEMENT (this "Agreement") is made and entered into as of the Effective Date by and between Plaintiff, Lone Star Technological Innovations, LLC, a limited liability company organized and existing under the laws of the State of Texas, having a principal place of business at 1999 Bryan Street, Suite 900, Dallas, Texas, 75201 ("Plaintiff"); and NEC Corporation, a Japanese Corporation having its principal of business at 7-1, Shiba 5-chrome, Minato-Ku, Tokyo, 108-8001, Japan (hereinafter referred to as "Defendant") and NEC Display Solutions, a Japanese Corporation having its principal of business at 4-28, Mita 1-chome, Minato-Ku, Tokyo, 108-0073, Japan (herein after referred to as "NECDS") (hereinafter referred to collectively "NEC"). Plaintiff, Defendant and NECDS are individually referred to herein as a "Party," and collectively as the "Parties."

WITNESSETH

WHEREAS, Plaintiff has filed an action against Defendant, for patent infringement in an action styled *Lone Star Technological Innovations, LLC v NEC Corporation*, Case No. 6:17-cv-687, related to Plaintiff's U.S. Patent Nos. 6,724,435 and 6,122,012 ("Patents-In-Suit") pending in the United States District Court for the Eastern District of Texas (the "Litigation");

WHEREAS Defendant denies infringement and alleges that the Patents-In-Suit are invalid and unenforceable;

WHEREAS Defendant in its answer alleges that it has a license to the Patent-In-Suit from its license agreement with Intel Corporation;

WHEREAS, this Agreement has not been negotiated under the "Hypothetical Negotiation" standard and the parties agree this settlement does not represent a reasonable royalty as this settlement is an agreement between the parties to resolve a commercial dispute; and

NOW, THEREFORE, in consideration of the above promises and mutual covenants hereinafter contained, the parties agree as follows:

1. DEFINITIONS

As used in this Agreement, the following terms shall have the following meanings:

"Affiliate" means, with respect to Plaintiff, any current and future (i) subsidiary of a Party or (ii) any Person in each case that is Controlling the Party, Controlled by the Party, or is under common Control with such Party.

"Licensed Affiliate" means (i) NECDS, (ii) any current and future subsidiary of NEC or (iii) any current and future Person that is Controlled by NEC.

For purposes of this Agreement, "control" shall exclusively mean the ownership, directly or indirectly, of more than fifty percent (50%) of the outstanding voting shares of such an entity, or an ownership right representing more than 50% of the rights to make decisions for such an entity. Notwithstanding the foregoing, with respect to Defendant, the term "Licensed Affiliates" excludes any Person that is a Party to a pending patent infringement claim or lawsuit filed by Plaintiff with respect to the Licensed Patents prior to controlling, becoming controlled by, or becoming under common control with Defendant.

"Licensed Products" means the products, product lines, services, devices, systems, components, hardware, software and any combination of the foregoing or provided by NEC and/or its Licensed Affiliates which would constitute, but for the license granted to NEC herein, an infringement, as defined by 35 U.S.C 271 as well as foreign equivalents thereof, of at least one claim of any of the Licensed Patents.

"Patents" mean, (i) all classes and/or types of patents, including utility patents, utility models, design patents, invention certificates, reexaminations, reissues, extensions and renewals anywhere in the world as well as foreign equivalents thereof; and (ii) all applications (including provisional and nonprovisional applications), continuations, divisionals,

continuations-in-part, and rights to inventions as well as foreign equivalents thereof for which applications may be filed, for these classes and/or types of patents.

“Person” means any individual, corporation, partnership, joint venture, limited liability company, association, trust, unincorporated organization, other legal entity, or natural person.

“Licensed Patents” means (i) all Patents listed in Exhibit B of this Agreement including the Patents-In-Suit, (ii) all continuations divisions, continuation-in-parts, reexaminations, reissues, extensions and renewals anywhere in the world of the Patent listed in Exhibit B owned or controlled by Plaintiff, its Affiliates; (iii) all Patents for which Patents may be filed arising from or sharing a priority date with either of (i) or (ii) above; (iv) any foreign counterparts of any of the foregoing.

“Third Party” means any person or entity other than a Party (including such Party’s Affiliates) to this Agreement.

2. LICENSE, RELEASES AND COVENANTS

- 2.1. License. Subject to compliance by NEC and its Licensed Affiliates with the terms and conditions of this Agreement, Plaintiff, on behalf of itself, its Affiliates, and their respective employees, hereby grants to NEC and its Licensed Affiliates for Licensed Products a fully paid-up, non-exclusive, non-sublicensable, non-transferable to Third Parties other than the Licensed Affiliate of NEC license to (i) make, have made, use, import, export, distribute, sell, offer for sale, lease, advertise and otherwise dispose of under the Licensed Patents solely with respect to the Licensed Products (ii) make, have made, use and import machines, tools, materials and other instrumentalities, insofar as such machines, tools, materials and other instrumentalities are required for the development, manufacture, testing or repair of Licensed Products which are or have been made, offered for sale, used, leased, owned, sold, exported or imported by NEC; and (iii) convey to any customer, distributor, and vendor of NEC and/or its Licensed Affiliates the rights to use, sell, offer for sale, lease, import, export, resell, transfer and otherwise dispose of such Licensed Products as sold, leased, transferred or otherwise disposed of by NEC and/or its Licensed Affiliates. For the avoidance of doubt, Section 2.1 shall not cover any Third Party products or services, except that the license grant set forth in this Section 2.1 shall include NEC’s and its Licensed Affiliates’ distributors, resellers, end users, and customers with respect to the Licensed Products.
- 2.2. Plaintiff Release of NEC. Subject to the payment provided under Section 3 and the compliance by NEC and its Licensed Affiliates with the terms and conditions of this Agreement, Plaintiff, on behalf of itself, its Affiliates, and their respective attorneys, insurers, agents, officers, directors and employees (“Plaintiff Releasing Party”) hereby, fully, irrevocably and forever releases, acquits, and discharges (a) NEC and its Licensed Affiliates, and their respective officers, directors, managers, members, employees, agents, experts, consultants and attorneys (collectively, “NEC Released Parties”) from any and all claims, counterclaims, demands, losses, costs, damages, debts, liabilities, obligations and causes of action (regardless of whether they are now known or unknown, suspected or unsuspected) that the Plaintiff Releasing Party may have on account of the NEC Released Party’s acts related to: (i) any act (including but not limited to making, having made, keeping, using, leasing, selling, offering to sell, importing, exporting, transferring, or otherwise disposing) of past, present, or future infringement, direct, contributory, or by inducement of any of the Licensed Patents solely with respect to the Licensed Products; (ii) the claims and counterclaims asserted in, and the conduct of, the Litigation; and (iii) the conduct of settlement negotiations occurring before the Effective Date (except for representations and obligations expressly included in this Agreement) and (b) third party vendors, suppliers, manufactures, developers, distributors, contractors, partners, hosts, customers and end-users of NEC and its Affiliates from liability solely with respect to making, having made, using, importing, exporting, developing, advertising, distributing, selling, offering for sale, or otherwise disposing of Licensed Products.
- 2.3. Plaintiff Covenant Not to Sue NEC. Subject to the payment provided under Section 3 and compliance by NEC and its Licensed Affiliates with the terms and conditions of this Agreement, Plaintiff, on behalf of itself, its Affiliates, and their managers covenants not to bring or prosecute any judicial, administrative, or other proceedings of any kind against NEC and its Licensed Affiliates for any claim under any Patents or any claim relating to, based upon, or arising under any Patents during the period of ten (10) years from the

Effective Date ("Covenant Period"). For the avoidance of doubt, this covenant set forth in this Section 2.3 shall not cover any Third Party products or services. Plaintiff further covenants not to sue NEC and its Affiliates, customers, licensees, depositors, end-users, suppliers, vendors, manufacturers, hosts, partners, distributors, contractors, developers, for actual or alleged infringement of any Patents, with respect to "Licensed Products." For the avoidance of doubt, covenant not to sue set forth in this Section 2.3 means that should any claim be brought against Licensed Products following the Covenant Period, no damages or other remedies shall be available or recoverable against any Licensed Product prior to the expiration of the Covenant Period.

- 2.4. NEC Release of Plaintiff. Subject to Plaintiff's compliance with the terms and conditions of this Agreement, NEC and its Licensed Affiliates release Plaintiff, its Affiliates and the Plaintiff Releasing Party from any and all claims, counterclaims, demands, losses, costs, damages, debts, liabilities, obligations and causes of action (regardless of whether they are now known or unknown, suspected or unsuspected) that the NEC Released Parties may have on account of the: (i) the Licensed Patents; (ii) the claims and counterclaims asserted or which could have been asserted in, and the conduct of, the Litigation; and (iii) the conduct of settlement negotiations occurring before the Effective Date (except for representations and obligations expressly included in this Agreement).
- 2.5. NEC Covenant Not to Sue Plaintiff. Subject to Plaintiff's compliance with the terms and conditions of this Agreement, NEC and its Licensed Affiliates covenant not to sue Plaintiff or its Affiliates for any claims related to the Licensed Patents. NEC and its Licensed Affiliates further covenant, represents and warrants that it shall not contest or assist in the contest in any forum, including Federal Courts, whether under 28 U.S.C. §§ 2201-2202 or not, the United States Patent and Trademark Office, and/or the International Trade Commission, that the Licensed Patents are valid and enforceable. NEC and its Licensed Affiliates reserve the right to contest the validity and enforceability of the Licensed Patents solely to the extent a claim of infringement under the Licensed Patents is brought against a NEC Released Party with respect to the Licensed Products. It is hereby agreed that complying with the requirements of law to provide information served by a Third Party (e.g. subpoena for document production) shall not be deemed a violation of this Section 2.5.
- 2.6. No Other Rights / No Exhaustion. No rights or covenants are granted under any patents except as expressly provided herein, whether by implication, estoppel or otherwise. Except as otherwise expressly granted in this Agreement, no right to grant covenants, rights, sublicenses or to become a foundry for Third Parties is granted under this Agreement.
- 2.7. Releases. The releases in this Agreement include an express, informed, knowing and voluntary waiver and relinquishment to the fullest extent permitted by law. In this connection, the parties acknowledge that they may have sustained damages, losses, costs or expenses which are presently unknown and unsuspected and that such damages, losses, costs or expenses as may have been sustained may give rise to additional damages, losses, costs or expenses in the future. The parties hereto further acknowledge that they have negotiated this Agreement taking into account presently unsuspected and unknown claims, counterclaims, causes of action, damages, losses, costs and expenses, and the parties hereto voluntarily and with full knowledge of its significance, expressly waive and relinquish any and all rights they may have under any state or federal statute, rule or common law principle, in law or equity, relating to limitations on general releases. The parties voluntarily and with full knowledge of its significance, expressly waive and relinquish any and all rights they may have under any state or federal statute, rule or common law principle, in law or equity, relating to limitations on releases. Specifically, each Party hereby expressly waives any rights it may have under California Civil Code Section 1542 (or any other similar law in any jurisdiction) which provides that: **"A general release does not extend to claims which the creditor does not know or suspect to exist in his favor at the time of executing the release, which if known by him must have materially affected his settlement with the debtor."**
- 2.8. Termination of Litigation. No later than five (5) business days after the Effective Date, the Parties shall request dismissal of the Litigation with prejudice by filing the form of dismissal attached hereto as Exhibit A, or by such other procedure as agreed to between the Parties or which may be reasonably necessary to dismiss the Litigation with prejudice.

3. ADDITIONAL CONSIDERATION

- 3.1. Payment. In consideration of the license, release and covenant granted by Plaintiff and the dismissal by Plaintiff of the Litigation hereunder in addition to all other consideration provided for in this Agreement, NECDS agrees to pay to Plaintiff a total of Two Hundred Fifty Thousand U.S. Dollars (\$250,000), payable in one payment by NECDS to Plaintiff no later than forty five (45) business days after the later of (a) the last signature date of this Agreement (the "Effective Date") or (b) the date NECDS receives from Plaintiff all necessary tax forms, including, but not limited to Certificate of Residence, Japanese Tax Forms 3 and 17, and an invoice of such payment from Plaintiff ("the Due Date"). Such \$250,000 U.S Dollars shall be delivered by wire transfer to the following account:

Banie & Ishimoto LLP Wells Fargo Trust Account

Beneficiary Name : Banie & Ishimoto LLP

Address : 3705 Haven Aven, #137, Menlo Park, CA 94025

Beneficiary Account Name : Banie & Ishimoto LLP

Account Number: [REDACTED]

Bank Name : Wells Fargo

Bank Address : 420 Montgomery Street, San Francisco, CA 94104

ABA No. :

Direct Deposits: [REDACTED]

Wire Transfers – Domestic: [REDACTED]

Swift Code for Transfers: WFBIUS6S

Banie & Ishimoto LLP is acting as a representative or agent of Lone Star Technological Innovations, LLC for payment receipt purposes, and Lone Star Technological Innovations, LLC is the real party in interest.

- 3.1.1 Any amounts payable by NEC that remain unpaid after the Due Date shall be subject to an annual interest rate of Prime (at the due date) plus 2%, from the due date until such amount is paid.
- 3.2. Taxes / Costs. The payment required by this Agreement shall not be reduced by NECDS for any taxes, levies, imposts, customs, duties, fees or similar charges imposed by any governmental authority of any nature including sales or use tax, excise tax, stamp tax or duty, any withholding or back up withholding tax and value added tax, except for tax imposed on Plaintiff in a jurisdiction outside the United States if and only to the extent such tax is allowable as a credit against the United States income taxes of Plaintiff. Each Party agrees to bear and be responsible for the payment of any taxes (including income taxes), levies, imposts, customs, duties, fees and charges that may be levied or assessed on it in connection with this Agreement. NECDS will not deduct or withhold any amounts from the payment to Licensor required under Section 3.1 of this Agreement as long as Plaintiff provides NECDS with all necessary tax forms and information. The parties agree that they shall bear their own costs and attorneys' fees relating to or arising from the Litigation and to the negotiation of this Agreement. Specifically, Plaintiff will be responsible for any taxes to which it is subject as a result of the payment made by NECDS to Plaintiff in accordance with Section 3.1 under this Agreement. Plaintiff acknowledges that the payment by NECDS to Plaintiff of the amount due under Article 3 may be subject to certain withholding tax requirements. Accordingly, Plaintiff shall promptly provide NECDS with all necessary forms and information related to such taxes and withholding requirements, including, without limitation, Japanese National Tax Agency Forms 3, 16 and 17, and an original United States residency certification (IRS Form 6166). Parties acknowledge that Plaintiff provided NECDS with drafts of Japanese National Tax Forms 3, 16, and 17; as well United States residency certification (IRS Form 6166). NECDS has provided, on January 11, 2019, a notice of additional documents and information necessary for exemption of Japanese withholding taxes that needs to be

provided by Plaintiff ("NECDS Tax Notice"). Plaintiff agrees that it and all those in privity with it will use their best efforts to provide assistance and information to NECDS in providing any additional required tax documentation and information that NECDS needs to submit to the Japanese National Tax Agency to get an approval of an exemption from Japanese withholding taxes, VAT, or other taxes, as the 2003 income tax treaty between United States and Japan exempts Lone Star from Japanese royalty withholding taxes. Each Party shall use commercially reasonable efforts to complete all tax forms and other documents required by applicable tax authorities and to provide the other Parties with any document required, in a timely manner, in order to avoid or minimize withholdings from any payments due under this Agreement or to claim the benefit of any favorable withholding rates under applicable tax treaties. If Plaintiff fails to provide to NECDS originals of any of the aforesaid tax documents within sixty (60) business days of the Effective Date or NECDS provided NECDS Tax Notice, NECDS may make the payment set forth in Section 3.1 above with any withholding tax deducted and NECDS shall later provide Plaintiff with a tax receipt from the Japanese National Tax Agency.

- 3.3. The amount in Section 3.1 shall be nonrefundable under any and all circumstances, including but not limited to the Licensed Patents being held invalid or unenforceable.

4. TERM AND TERMINATION

- 4.1. Term. The term of this Agreement shall commence upon the Effective Date and shall continue until the expiration of the last-to-expire of the Licensed Patents, unless earlier terminated by Plaintiff.

5. ASSIGNMENT

- 5.1. No Assignment. Except as set forth below, neither Party may assign (by contract, operation of law or otherwise) its rights under this Agreement without the prior written consent of the other Party and any attempt to assign without such permission will be void.
- 5.2. Permitted Assignment by NEC. NEC may assign its rights under this Agreement, in whole or in part, without Plaintiff's prior written consent: (i) as part of a merger (in which it is not the surviving entity) with, or (ii) sale of all or substantially all of its assets or shares to, a Third Party acquirer (an "Acquirer"), provided that, in case of the (ii) above, (a) the Acquirer is not a Party to a written communication by Plaintiff asserting a patent infringement claim or lawsuit filed by Plaintiff with respect to one or more of the Licensed Patents and pending at the time NEC conducts such sale, transfer or spin-off; and (b) the rights of NEC hereunder so assigned, including any licenses, releases and covenants not to sue only extend to (aa) Licensed Products existing as of the date of such sale, transfer or spin-off; or (bb) any improvement, upgrades updates to (aa); or (cc) Licensed Products to be made, had made, sold, offered for sale according to the product road map of NEC, which product road map was in existence prior to the assignment, as supported by NEC's written evidence; and will not extend to any other products, services or activities, including those of the Acquirer or any of its Affiliates. In addition to the foregoing, all releases and covenants of NEC contained herein shall run with the rights of NEC being assigned or transferred and shall be binding on any successors-in-interest, transferees, or assigns thereof. NEC shall not assign or otherwise transfer any right hereunder to any other party unless (i) such sale or assignment is subject to all of the terms and conditions of this Agreement, and (ii) such other party executes an agreement agreeing to be bound by all of the terms and conditions of this Agreement with respect to the rights being transferred or assigned.
- 5.3. All rights, releases, licenses and covenants contained herein shall run with the Licensed Patents and shall be binding on any successors-in-interest, assigns thereof, or exclusive licensees. Plaintiff, and its Affiliates shall not assign, sell, exclusively license or otherwise transfer or grant any ownership right or right to enforce or recover under any of Licensed Patents to any other party without the same being subject to the rights, covenants, licenses and releases provided by Plaintiff or Plaintiff's Affiliate under this Agreement. Subject to the foregoing, this Agreement shall be binding upon and inure to the benefit of the Parties and their permitted successors and assigns.

6. MISCELLANEOUS PROVISIONS

6.1. Representations:

6.1.1. Plaintiff Representations: Plaintiff represents and warrants, with respect to the currently existing Licensed Patents only, as of the Effective Date that: (i) Plaintiff, on behalf of itself, its Affiliates and entities which share the same board member as Plaintiff, and their respective employees owns and/or controls the Licensed Patents, and has the sufficient right, title and interest to grant the license, releases and covenants with respect to the Licensed Patents of the full scope set forth herein; (ii) it has not assigned or otherwise transferred to any other Person any rights to the Licensed Patents or any claims based on the Licensed Patents that would prevent Plaintiff from entering into and fully performing this Agreement; (iii) the person executing this Agreement on behalf of Plaintiff has the full right and authority to enter into this Agreement on Plaintiff's behalf and Plaintiff has the authority to enter into this Agreement; and (iv) Plaintiff is a corporation in good standing under the laws of the state of Texas. Plaintiff further represents and warrants that it understands that it is has exclusively negotiated and is contracting with NEC, and acknowledges it is not contracting (directly or indirectly, by any legal theory or otherwise) with any other Person or any Third Party and no Person other than Plaintiff and NEC are parties to this Agreement (directly or indirectly, by implication or under any legal theory or otherwise). Plaintiff further represents and warrants, as of the Effective Date, neither Plaintiff, its Affiliates, nor their respective employees are aware of any Patents other than the Licensed Patents which could be asserted against NEC and its Licensed Affiliates by Plaintiff or its Affiliates through themselves or any other individual or entity.

6.1.2. NEC Representations: NEC represents and warrants as of the Effective Date that: (i) NEC has the right to grant the releases and covenants of the full scope set forth herein and (ii) the person executing this Agreement on behalf of NEC has the full right and authority to enter into this Agreement on NEC's behalf. NEC further represents and warrants that it understands that it is has exclusively negotiated and is contracting with Plaintiff, and acknowledges it is not contracting (directly or indirectly, by any legal theory or otherwise) with any other Person or any Third Party and no Person other than Plaintiff and NEC are Parties to this Agreement (directly or indirectly, by implication or under any legal theory or otherwise).

6.1.3. No Warranties. Unless otherwise expressly stated in this Agreement, nothing contained in this Agreement shall be construed as: (i) a warranty or representation by either Party that any manufacture, sale, use or other disposition of products by the other Party has been or will be free from infringement of any patents of any Third Party; (ii) an agreement by either Party to bring or prosecute actions or suits against third parties for infringement, or conferring any right to the other Party to bring or prosecute actions or suits against third parties for infringement; (iii) conferring any right to the other Party to use in advertising, publicity, or otherwise, any trademark, trade name or names of either Party, or any contraction, abbreviation or simulation thereof without the prior written consent of the other Party; or (iv) conferring by implication, estoppel or otherwise, upon either Party, any right (including a license) under other patents except for the rights expressly granted hereunder.

6.2. Confidentiality. From and after the Effective Date, neither Party shall disclose the terms of this Agreement except:

6.2.1. with the prior written consent of the other Party;

6.2.2. to any governmental body having jurisdiction and specifically requiring such disclosure;

6.2.3. in response to a valid subpoena or as otherwise may be required by law;

6.2.4. for the purposes of disclosure in connection with the Securities and Exchange Act of 1934, as amended, the Securities Act of 1933, as amended, and any other reports filed with the Securities and Exchange Commission, or any other filings, reports or disclosures that may be required under applicable laws or regulations;

- 6.2.5. to a Party's accountants, legal counsel, tax advisors and other financial and legal advisors, subject to obligations of confidentiality and/or privilege at least as stringent as those contained herein;
- 6.2.6. as required during the course of litigation and subject to protective order; provided however, that any production under a protective order would be protected under an "Attorneys Eyes Only" or higher confidentiality designation and a Party disclosing the terms of this Agreement shall provide an advance written notice to the other Party(ies) at least ten (10) business days prior to the disclosure to allow the other Party(ies) an opportunity to raise any objections to the disclosure; or with obligations of confidentiality at least as stringent as those contained herein, to a counterparty in connection with a proposed merger, acquisition, financing or similar transaction and/or in order to comply with the provisions of Section 3.4 above, provided that in such circumstances only a legal brief will be given; provided, however, that prior to any such disclosure pursuant to paragraphs 6.2.2, 6.2.3, 6.2.4 and 6.2.6 hereof, the Party seeking disclosure shall promptly notify the other Party and take all reasonable actions in an effort to minimize the nature and extent of such disclosure. In furtherance hereof, NEC will direct its counsel to promptly return to Plaintiff counsel any documents provided to NEC or its counsel by Plaintiff or its counsel.
- 6.3. Notices. All notices required or permitted to be given hereunder shall be in writing and shall be delivered by hand, or, if dispatched by prepaid air courier, with package tracing capabilities or by registered or certified airmail, postage prepaid, addressed as follows:

If to Plaintiff:

John Lee
Banie & Ishimoto LLP
3705 Have Ave. #137
Menlo Park, CA 94025

If to NEC:

NEC Corporation
7-1, 5-chome, Minato-ku, Tokyo 108-8001, Japan
Attention: Department Manager, Licensing Department, Intellectual Property Management Division
info@license.jp.nec.com

NEC Display Solutions, Ltd.
4-28, Mita 1-chome, Minato-ku, Tokyo 108-0073, Japan
Attention: General Manager, Intellectual Property Division
ip_division@necds.jp.nec.com

Such notices shall be deemed to have been served when received by addressee. Either Party may give written notice of a change of address and, after notice of such change has been received, any notice or request shall thereafter be given to such Party as above provided at such changed address.

- 6.4. Publicity. Neither Party will issue a press release or any other announcement regarding this Agreement or the relationship contemplated herein unless both parties provide prior consent in writing. The parties shall direct their representatives not to make any disclosures of the terms of this Agreement. Notwithstanding the foregoing and Section 6.2 above, (i) upon inquiry either Party may state that Plaintiff and NEC have entered into a patents in suit settlement agreement, (ii) upon inquiry by NEC Released Parties, NEC or its Affiliates may disclose to such NEC Released Parties the general terms of the license, covenant and release granted under this Agreement and (iii) Plaintiff may make the following statements: "NEC Corporation and certain of its Affiliates have been licensed to certain Lone Star Technological Innovations, LLC patents."

- 6.5. Governing Law / Jurisdiction. This Agreement and matters connected with the performance thereof shall be construed, interpreted, applied and governed in all respects in accordance with the laws of the United States of America and the State of Delaware, without reference to conflict of laws principles.
- 6.6. Sophisticated Parties Represented by Counsel. The parties each acknowledge, accept, warrant and represent that (i) they are sophisticated parties represented at all relevant times during the negotiation and execution of this Agreement by counsel of their choice, and that they have executed this Agreement with the consent and on the advice of such independent legal counsel, and (ii) they and their counsel have determined through independent investigation and robust, arm's-length negotiation that the terms of this Agreement shall exclusively embody and govern the subject matter of this Agreement.
- 6.7. Bankruptcy. Each Party confirms that the licenses and other rights granted under the Licensed patents under this Agreement are, for the purpose of 11 U.S.C. 365 (n) rights to "intellectual property" as defined in 11 U.S.C. 101. Each Party irrevocably waives all arguments and defenses arising under 11 U.S.C. 365(c)(1) or successor provisions to the effect that applicable law excuses the party, other than the debtor, from accepting performance from or rendering performance to an entity other than the debtor or debtor in possession as a basis for opposing assumption of the Agreements by the other party in a case under Chapter 11 of the Bankruptcy Code to the extent that such consent is required under 11 U.S.C. § 365(c)(1) or any successor statute. Any change of control resulting from any such bankruptcy proceeding shall remain subject to Section 5 above.
- 6.8. Severability. If any provision of this Agreement is held to be illegal or unenforceable, such provision shall be limited or eliminated to the minimum extent necessary so that the remainder of this Agreement will continue in full force and effect and be enforceable. The parties agree to negotiate in good faith and to enforce a substitute provision for any invalid or unenforceable provision that most nearly achieves the intent of such provision.
- 6.9. Entire Agreement. The parties acknowledge, accept, warrant and represent that (i) this is an enforceable agreement; (ii) this Agreement embodies the entire and only understanding of each of them with respect to the subject matter of the Agreement, and merges, supersedes and cancels all previous representations, warranties, assurances, conditions, definitions, understandings or any other statement, express, implied, or arising by operation of law, whether oral or written, whether by omission or commission between and among them with respect to the subject matter of the Agreement; (iii) no oral explanation or oral information by either Party hereto shall alter the meaning or interpretation of this Agreement; (iv) the terms and conditions of this Agreement may be altered, modified, changed or amended only by a written agreement executed by duly authorized representatives of Plaintiff and NEC, (v) the language of this Agreement has been approved by counsel for each of them, and shall be construed as a whole according to its fair meaning, and (vi) none of them (nor their respective counsel) shall be deemed to be the draftsman of this Agreement in any action which may hereafter arise with respect to the Agreement.
- 6.10. Modification; Waiver. No modification or amendment to this Agreement, nor any waiver of any rights, will be effective unless assented to in writing by the Party to be charged, and the waiver of any breach or default will not constitute a waiver of any other right hereunder or any subsequent breach or default.
- 6.11. Construction; Language. Any rule of construction to the effect that ambiguities are to be resolved against the drafting Party will not be applied in the construction or interpretation of this Agreement. As used in this Agreement, the words "include" and "including" and variations thereof, will not be deemed to be terms of limitation, but rather will be deemed to be followed by the words "without limitation." The headings in this Agreement will not be referred to in connection with the construction or interpretation of this Agreement. This Agreement is in the English language only, which language shall be controlling in all respects, and all notices under this Agreement shall be in the English language.
- 6.12. Counterparts. This Agreement may be executed in counterparts or duplicate originals, both of which shall be regarded as one and the same instrument, and which shall be the official and governing version in the interpretation of this Agreement. This Agreement may be executed by facsimile signatures or

other electronic means and such signatures shall be deemed to bind each party as if they were original signatures.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be signed below by their respective duly authorized officers.

LONE STAR TECHNOLOGICAL INNOVATIONS, LLC

By: *Jesse Rice*
Name: Jesse Rice
Title: Manager
Date: January 17, 2019

NEC CORPORATION

By: _____
Name: _____
Title: _____
Date: _____

NEC DISPLAY SOLUTIONS, LTD

By: _____
Name: _____
Title: _____
Date: _____

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be signed below by their respective duly authorized officers.

LONE STAR TECHNOLOGICAL INNOVATIONS, LLC

By: _____

Name: _____

Title: _____

Date: _____

NEC CORPORATION

By: Shigeki Wada

Name: Shigeki Wada

Title: General Manager,
Intellectual Property Management Division

Date: January 18, 2019

NEC DISPLAY SOLUTIONS, LTD

By: Atsushi Yamashita

Name: Atsushi Yamashita

Title: General Manager

Date: January 18, 2019

EXHIBIT A

STIPULATED MOTION FOR DISMISSAL WITH PREJUDICE

The Plaintiff, Lone Star Technological Innovations, LLC and Defendant NEC Corporation pursuant to Fed. R. Civ. P. 41(a)(2) and (c), hereby move for an order dismissing all claims and counterclaims in this action WITH PREJUDICE, subject to the terms of that certain agreement entitled “**PATENT LICENSE AND SETTLEMENT AGREEMENT**” and dated January __, 2018, with each Party to bear its own costs, expenses and attorneys’ fees.

ORDER OF DISMISSAL WITH PREJUDICE

CAME ON THIS DAY for consideration of the Stipulated Motion for Dismissal With Prejudice of all claims and counterclaims asserted between plaintiff, Lone Star Technological Innovations, LLC, and Defendant NEC CORPORATION, in this case, and the Court being of the opinion that said motion should be GRANTED, it is hereby

ORDERED, ADJUDGED AND DECREED that all claims and counterclaims asserted in this suit between plaintiff, Lone Star Technological Innovations, LLC, and Defendant NEC Corporation, are hereby dismissed with prejudice, subject to the terms of that certain agreement entitled “**PATENT LICENSE AND SETTLEMENT AGREEMENT**” and dated January __, 2018.

It is further ORDERED that all attorneys’ fees and costs are to be borne by the Party that incurred them.

EXHIBIT B

US 6,191,827
US 6,724,435
US 6,122,012
US 6,178,272
US 7,577,291
US 7,391,416
US 7,512,269
CA 2363727
CA 2365629
CN 134334
CN 101233539
DE 60042111
EP 1157353
EP 1157565
EP 1163797
EP 1428395
EP 1147658
EP 1157340
IL 145195
IL 145196
JP 4351394
JP 4489961
JP 2000-590384
JP 2000-602940
JP 4452498
JP 2002538738
JP 2003523106
KR 1020010113722
KR 1020010114217
NZ 513874
SG 84092
TWI 319167
WO WO/2003/060623
WO WO/2003/015391
WO WO/2000/038422
WO WO/2000/046740
WO WO/2000/052938
WO WO/2000/052587
WO WO/2000/033564
WO WO/2007/019265

PATENT LICENSE AND SETTLEMENT AGREEMENT

This PATENT LICENSE AND SETTLEMENT AGREEMENT (this "Agreement") is made and entered into as of December 8, 2016 (the "Effective Date") by and between Plaintiff Lone Star Technological Innovations, LLC, a limited liability company organized and existing under the laws of the State of Texas, having a principal place of business at 1999 Bryan Street, Suite 900, Dallas, Texas, 75201 ("Plaintiff"); and Sharp Electronics Corporation, a New York Corporation having its principal place of business at 100 Paragon Drive in Montvale, NJ 07645 (hereinafter referred to as "SEC") and Sharp Corporation, a Japanese Corporation having its principal of business, 1 Takumi-cho, Sakai-ku, Sakai City, Osaka 590-8522, Japan (hereinafter referred to as "SC") (hereinafter referred to collectively "Defendant"). Plaintiff and Defendant are individually referred to herein as a "party," and collectively as the "parties."

WITNESSETH

WHEREAS, Plaintiff has filed an action against Defendant, for patent infringement in an action styled *Lone Star Technological Innovations, LLC v Sharp Electronics Corporation*, Case No. 6:15-cv-972, related to Plaintiff's U.S. Patent Nos. 6,724,435 and 6,122,012 ("Patents-In-Suit") pending in the United States District Court for the Eastern District of Texas (the "Litigation").

WHEREAS Defendant denies infringement and alleges that the Patents-in-Suit are invalid and unenforceable;

WHEREAS During the negotiations of this Agreement, Defendant represented that it has discontinued selling or manufacturing certain accused products in the United States. In particular, Defendant represented that, apart from possible residual inventory, SEC has stopped selling DTVs for purchase by consumers in the U.S. and SEC has also stopped selling projectors in the U.S. SEC further represents that SC currently does not have plans to again make DTVs for purchase by consumers in the U.S. and there are no plans for SEC to again sell DTVs for purchase by consumers in the U.S.

WHEREAS as of January 2016, DTVs branded as "Sharp" sold in consumer channels in the United States are manufactured by Hisense International Co. Ltd. and its subsidiaries, a third party multinational company headquartered in China (Collectively known hereafter as "Hisense"), under a branding license agreement ("the Hisense Branding Agreement").

WHEREAS Defendant agrees that the Hisense Branding Agreement does not confer any rights under this Agreement.

WHEREAS, this Agreement has not been negotiated under the "Hypothetical Negotiation" standard and the parties agree this settlement does not represent a reasonable royalty as this settlement is an agreement between the parties to resolve a commercial dispute;

NOW, THEREFORE, in consideration of the above promises and mutual covenants hereinafter contained, the parties agree as follows:

1. DEFINITIONS

As used in this Agreement, the following terms shall have the following meanings:

"Affiliate" means, with respect to plaintiff, any current and future (i) subsidiary of a party or (ii) any individual, trust, corporation, partnership, joint venture, limited liability company, association, unincorporated organization or other legal entity; in each case that is controlling the party, controlled by the party, or is under common control with such party.

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**Pl's Trial
Exhibit**

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exhibitsticker.com

“Licensed Affililate” means any current and future (i) subsidiary of Sharp Electronics Corporation or (ii) any individual trust, corporation, partnership, joint venture, limited liability company, association, unincorporated organization or other legal entity in each case that is controlled by Sharp Electronics Corporation.

For purposes of this Agreement, “control” shall exclusively mean the ownership, directly or indirectly, of fifty percent (50%) or more of the outstanding voting shares of such an entity, or an ownership right representing more than 50% of the rights to make decisions for such an entity. Notwithstanding the foregoing, with respect to Defendant, the term “Licensed Affiliates” excludes any Person that is a party to a pending patent infringement claim or lawsuit filed by Plaintiff with respect to the Licensed Patents prior to controlling, becoming controlled by, or becoming under common control with Defendant. Additionally, Hisense is not an Affiliate for purposes of this Agreement.

“Licensed Products” means the products and services of or provided by Defendants and/or its Licensed Affiliates which would constitute, but for the license granted to Defendant herein, an infringement, as defined by 35 U.S.C 271 of any claims of any of the Licensed Patents. Hisense’s products, however branded, are not Licensed Products for the purposes of this Agreement.

“Patents” mean, (i) all classes and/or types of patents, including utility patents, utility models, design patents, invention certificates, reexaminations, reissues, extensions and renewals anywhere in the world; and (ii) all applications (including provisional and nonprovisional applications), continuations, divisionals, continuations-in-part, and rights to inventions for which applications may be filed, for these classes and/or types of patents.

“Person” means any individual, corporation, partnership, joint venture, trust, unincorporated organization, or other legal entity.

“Licensed Patents” means the United States Nos. 6,724,435 and 6,122,012 and includes (i) all classes and/or types of patents, including utility patents, utility models, design patents, invention certificates, reexaminations, reissues, extensions and renewals anywhere in the world arising from or sharing a priority date with either patent; and (ii) all applications (including provisional and nonprovisional applications), continuations, divisionals, continuations-in-part, and rights to inventions for which applications may be filed arising from or sharing a priority date with either patent..

“Third Party” means any person or entity other than a party (including such party’s Affiliates) to this Agreement.

2. LICENSE, RELEASES AND COVENANTS

- 2.1. License. Subject to compliance by Defendant and its Licensed Affiliates with the terms and conditions of this Agreement, Plaintiff, on behalf of itself, its Affiliates, and their respective employees, hereby grants to Defendant and its Licensed Affiliates for Licensed Products a royalty-free, non-exclusive, non-sublicensable, non-transferable to Third Parties other than the Licensed Affiliate of Defendants license to (i) make, have made, use, import, export, distribute, sell, offer for sale, lease, and advertise under the Licensed Patents solely with respect to the Licensed Products (ii) make, have made, use and import machines, tools, materials and other instrumentalities, insofar as such machines, tools, materials and other instrumentalities are required for the development, manufacture, testing or repair of Licensed Products which are or have been made, offered for sale, used, leased, owned, sold, exported or imported by Defendant; and (iii) convey to any customer of Defendant and/or its Licensed Affiliates the rights to use, offer for sale, lease, import, export, resell, transfer and otherwise dispose of such Licensed Products as sold, leased, transferred or otherwise disposed of by Defendant and/or its Licensed Affiliates. For the avoidance of doubt, Section 2.1 shall not cover any Third Party products or services, except that the license grant set forth in this Section 2.1 shall include Defendant’s and its Licensed Affiliates’ distributors, resellers, end users, and customers with respect to the Licensed Products. Lone Star acknowledges that despite the Hisense Branding Agreement, there may still be residual Defendant accused products sold in consumer channels in the United States that are licensed under this Agreement. Lone Star further acknowledges that there are products other than DTVs for purchase by consumers in the U.S. and projectors that are licensed under this Agreement.

- 2.2. Plaintiff Release of Defendant. Subject to the payment provided under Section 3 and the compliance by Defendant and its Licensed Affiliates with the terms and conditions of this Agreement, Plaintiff, on behalf of itself, its Affiliates, and their respective attorneys, insurers, agents, officers, directors and employees (“Plaintiff Releasing Party”) hereby, fully, irrevocably and forever releases, acquits, and discharges Defendant and its Licensed Affiliates, and their respective officers, directors, managers, members, employees, agents, experts, consultants and attorneys (collectively, “Defendant Released Parties”) from any and all claims, counterclaims, demands, losses, costs, damages, debts, liabilities, obligations and causes of action (regardless of whether they are now known or unknown, suspected or unsuspected) that the Plaintiff Releasing Party may have on account of the Defendant Released Party’s acts related to: (i) any act (including but not limited to making, having made, keeping, using, leasing, selling, offering to sell, importing, exporting, transferring, or otherwise disposing) of past, present, or future infringement, direct, contributory, or by inducement of any of the Licensed Patents solely with respect to the Licensed Products; (ii) the claims and counterclaims asserted in, and the conduct of, the Litigation; and (iii) the conduct of settlement negotiations occurring before the Effective Date (except for representations and obligations expressly included in this Agreement).
- 2.3. Plaintiff Covenant Not to Sue Defendant. Subject to the payment provided under Section 3 and compliance by Defendant and its Licensed Affiliates with the terms and conditions of this Agreement, Plaintiff, on behalf of itself and its Affiliates covenants not to sue Defendant, its Licensed Affiliates, and their respective customers for infringement of the Licensed Patents solely with respect to the Licensed Products.
- 2.4. Defendant Release of Plaintiff. Subject to Plaintiff’s compliance with the terms and conditions of this Agreement, Defendant, on behalf of the Defendant Released Parties releases Plaintiff, its Affiliates and the Plaintiff Releasing Party from any and all claims, counterclaims, demands, losses, costs, damages, debts, liabilities, obligations and causes of action (regardless of whether they are now known or unknown, suspected or unsuspected) that the Defendant Released Parties may have on account of the: (i) the Licensed Patents; (ii) the claims and counterclaims asserted or which could have been asserted in, and the conduct of, the Litigation; and (iii) the conduct of settlement negotiations occurring before the Effective Date (except for representations and obligations expressly included in this Agreement).
- 2.5. Defendant Covenant Not to Sue Plaintiff. Subject to Plaintiff’s compliance with the terms and conditions of this Agreement, Defendant on behalf of itself and its Licensed Affiliates, covenants not to sue Plaintiff or its Affiliates for any claims related to the Licensed Patents. Defendant further covenants, represents and warrants that it shall not contest or assist in the contest in any forum, including Federal Courts, whether under 28 U.S.C. §§ 2201-2202 or not, the United States Patent and Trademark Office, and/or the International Trade Commission, that the Licensed Patents are valid and enforceable. Defendant reserves the right to contest the validity and enforceability of the Licensed Patents solely to the extent a claim of infringement under the Licensed Patents is brought against a Defendant Released Party with respect to the Licensed Products. It is hereby agreed that complying with the requirements of law to provide information served by a Third Party (e.g. subpoena for document production) shall not be deemed a violation of this Section 2.5.
- 2.6. No Other Rights / No Exhaustion. No rights or covenants are granted under any patents except as expressly provided herein, whether by implication, estoppel or otherwise. Except as otherwise expressly granted in this Agreement, no right to grant covenants, rights, sublicenses or to become a foundry for Third Parties is granted under this Agreement.
- 2.7. Releases. The releases in this Agreement include an express, informed, knowing and voluntary waiver and relinquishment to the fullest extent permitted by law. In this connection, the parties acknowledge that they may have sustained damages, losses, costs or expenses which are presently unknown and unsuspected and that such damages, losses, costs or expenses as may have been sustained may give rise to additional damages, losses, costs or expenses in the future. The parties hereto further acknowledge that they have negotiated this Agreement taking into account presently unsuspected and unknown claims, counterclaims, causes of action, damages, losses, costs and expenses, and the parties hereto voluntarily and with full knowledge of its significance, expressly waive and relinquish any and all rights they may have under any state or federal statute, rule or common law principle, in law or equity, relating to limitations on general releases. The parties voluntarily and with full knowledge of its significance, expressly waive and relinquish any and all rights they

may have under any state or federal statute, rule or common law principle, in law or equity, relating to limitations on releases. Specifically, each party hereby expressly waives any rights it may have under California Civil Code Section 1542 (or any other similar law in any jurisdiction) which provides that: **"A general release does not extend to claims which the creditor does not know or suspect to exist in his favor at the time of executing the release, which if known by him must have materially affected his settlement with the debtor."**

- 2.8. Termination of Litigation. No later than five (5) business days after receipt of Payment by Plaintiff, set forth in section 3.1, or such time as required by the Court, the Parties shall request dismissal of the Litigation with prejudice by filing the form of dismissal attached hereto as Schedule A, or by such other procedure as agreed to between the Parties or which may be reasonably necessary to dismiss the Litigation with prejudice.

3. ADDITIONAL CONSIDERATION

- 3.1. Payment. In consideration of the release and covenant granted by Plaintiff and the dismissal by Plaintiff of the Litigation hereunder in addition to all other consideration provided for in this Agreement, Defendant agrees to pay to Plaintiff a total of FOUR HUNDRED THIRTY FIVE THOUSAND U.S. Dollars (\$435,000), payable in one cash payment by Defendant to Plaintiff no later than forty-five (45) Days after the later of (a) the last signature date of this Agreement or (b) the date Defendant receives from Plaintiff all necessary tax forms, including, but not limited to Certificate of Residence, Japanese Tax Forms 3 and 17, such that \$435,000 U.S Dollars shall be delivered by wire transfer to the following account:

Banie & Ishimoto LLP Wells Fargo Trust Account

Account Number: [REDACTED]

Routing Numbers

Direct Deposits: [REDACTED]

Wire Transfers – Domestic: [REDACTED]

Swift Code for Transfers: WFBIOUS6S

- 3.2. Taxes / Costs. The payment required by this Agreement shall not be reduced by Defendant for any taxes, levies, imposts, customs, duties, fees or similar charges imposed by any governmental authority of any nature including sales or use tax, excise tax, stamp tax or duty, any withholding or back up withholding tax and value added tax, except for tax imposed on Plaintiff in a jurisdiction outside the United States if and only to the extent such tax is allowable as a credit against the United States income taxes of Plaintiff. Each Party agrees to bear and be responsible for the payment of any taxes (including income taxes), levies, imposts, customs, duties, fees and charges that may be levied or assessed on it in connection with this Agreement. Defendant will not deduct or withhold any amounts from the payment to Licensor required under Section 3.1 of this Agreement. The parties agree that they shall bear their own costs and attorneys' fees relating to or arising from the Litigation and to the negotiation of this Agreement. Specifically, Plaintiff will be responsible for any taxes to which it is subject as a result of the payment made by Defendant to Plaintiff in accordance with Section 3.1 under this Agreement. Plaintiff acknowledges that the payment by Defendant to Plaintiff of the amount due under Article 3 may be subject to certain withholding tax requirements. Accordingly, Plaintiff shall promptly provide Defendant with all necessary forms and information related to such taxes and withholding requirements, including, without limitation, Japanese National Tax Agency Forms 3, 16 and 17, and an original United States residency certification (IRS Form 6166). Plaintiff agrees that it and all those in privity with it will use their best efforts to provide assistance and information to Defendant in providing any additional required tax documentation and information that Defendant needs to submit to the Japanese National Tax Agency to get an approval of an exemption from Japanese withholding taxes, VAT, or other taxes. Each Party shall use commercially reasonable efforts to complete all tax forms

and other documents required by applicable tax authorities and to provide the other Parties with any document required, in a timely manner, in order to avoid or minimize withholdings from any payments due under this Agreement or to claim the benefit of any favorable withholding rates under applicable tax treaties.

3.3. Stand Still of the Litigation and Dismissal. Immediately following the execution of this Agreement, the Parties shall jointly advise the court presiding over the Litigation on a confidential basis that such action is pending settlement and that, subject to the terms and satisfaction of conditions of a confidential Agreement between the Parties and payment of the monetary consideration under Section 3.1, a motion to dismiss will be filed. The Parties shall also request, if applicable, that all outstanding deadlines in any procedural schedule be stayed or suspended pending dismissal. Within five (5) court days after the payment of the consideration to Plaintiff under this Section 3, the parties shall cause their respective counsel to execute and file the stipulated motion in the form set forth in Exhibit A dismissing with prejudice all claims and counterclaims between the parties in the Litigation. The parties shall promptly proceed with any and all additional procedures needed to dismiss with prejudice the Litigation. The parties acknowledge and agree that this Agreement is enforceable according to its terms with respect to final dismissal with prejudice of all claims and counterclaims in the Litigation.

3.4. The amount in Section 3.1 shall be nonrefundable under any and all circumstances, including but not limited to the Licensed Patents being held invalid or unenforceable.

4. TERM AND TERMINATION

4.1. Term. The term of this Agreement shall commence upon the Effective Date and shall continue until the expiration of the last-to-expire of the Licensed Patents, unless earlier terminated by Plaintiff as set forth below.

5. ASSIGNMENT

5.1. No Assignment. Except as set forth below, neither party may assign (by contract, operation of law or otherwise) its rights under this Agreement without the prior written consent of the other and any attempt to assign without such permission will be void.

(a) Permitted Assignment by Defendant. Defendant may assign its rights under this Agreement, in whole or in part, without Plaintiff's prior written consent: (i) as part of a merger (in which it is not the surviving entity) with, or sale of all or substantially all of its assets or shares to, a Third Party acquirer (an "Acquirer"), provided that (a) the Acquirer is not a party to a written communication by Plaintiff asserting a patent infringement claim or lawsuit filed by Plaintiff with respect to one or more of the Licensed Patents and pending at the time Defendant conducts such sale, transfer or spin-off; and (b) the rights of Defendant hereunder so assigned, including any licenses, releases and covenants not to sue only extend to (aa) Licensed Products existing as of the date of such sale, transfer or spin-off; or (bb) any improvement, upgrades updates to (aa); or (cc) Licensed Products to be made, had made, sold, offered for sale according to the product road map of Defendant, which product road map was in existence prior to the assignment, as supported by Defendant's written evidence; and will not extend to any other products, services or activities, including those of the Acquirer or any of its Affiliates. In addition to the foregoing, all releases and covenants of Defendant and its Licensed Affiliates contained herein shall run with the rights of Defendant being assigned or transferred and shall be binding on any successors-in-interest, transferees, or assigns thereof. Defendant shall not assign or otherwise transfer any right hereunder to any other party unless (i) such sale or assignment is subject to all of the terms and conditions of this Agreement, and (ii) such other party executes an agreement agreeing to be bound by all of the terms and conditions of this Agreement with respect to the rights being transferred or assigned.

(b) Permitted Assignment by Plaintiff. Notwithstanding the provisions of Section 5.1, Plaintiff shall be permitted to assign this Agreement to an Affiliate.

5.2. All rights, releases, licenses and covenants contained herein shall run with the Licensed Patents and shall be binding on any successors-in-interest, assigns thereof, or exclusive licensees. Plaintiff and its Affiliates shall not assign, sell, exclusively license or otherwise transfer or grant any ownership right or right to enforce or recover under any of Licensed Patents to any other party without the same being subject to the rights, covenants, licenses and releases provided by Plaintiff or Plaintiff's Affiliate under this Agreement. Subject to the foregoing, this Agreement shall be binding upon and inure to the benefit of the Parties and their permitted successors and assigns.

6. MISCELLANEOUS PROVISIONS

6.1. Representations:

6.1.1. Plaintiff Representations: Plaintiff represents and warrants, with respect to the currently existing Licensed Patents only, as of the Effective Date that: (i) Plaintiff, on behalf of itself and its Affiliates, owns and/or controls the Licensed Patents, and has the sufficient right, title and interest to grant the license, releases and covenants with respect to the Licensed Patents of the full scope set forth herein; (ii) it has not assigned or otherwise transferred to any other Person any rights to the Licensed Patents that would prevent Plaintiff from entering into this Agreement; (iii) the person executing this Agreement on behalf of Plaintiff has the full right and authority to enter into this Agreement on Plaintiff's behalf and Plaintiff has the authority to enter into this Agreement; and (iv) Plaintiff is a corporation in good standing under the laws of the state of Texas. Plaintiff further represents and warrants that it understands that it is has exclusively negotiated and is contracting with Defendant, and acknowledges it is not contracting (directly or indirectly, by any legal theory or otherwise) with any other Person or any Third Party and no Person other than Plaintiff and Defendant are parties to this Agreement (directly or indirectly, by implication or under any legal theory or otherwise).

6.1.2. Defendant Representations: Defendant represents and warrants as of the Effective Date that: (i) Defendant has the right to grant the releases and covenants of the full scope set forth herein and (ii) the person executing this Agreement on behalf of Defendant has the full right and authority to enter into this Agreement on Defendant's behalf. Defendant further represents and warrants that it understands that it is has exclusively negotiated and is contracting with Plaintiff, and acknowledges it is not contracting (directly or indirectly, by any legal theory or otherwise) with any other Person or

any Third Party and no Person other than Plaintiff and Defendant are parties to this Agreement (directly or indirectly, by implication or under any legal theory or otherwise).

- 6.1.3. No Warranties. Unless otherwise expressly stated in this Agreement, nothing contained in this Agreement shall be construed as: (i) a warranty or representation by either party that any manufacture, sale, use or other disposition of products by the other party has been or will be free from infringement of any patents; (ii) an agreement by either party to bring or prosecute actions or suits against third parties for infringement, or conferring any right to the other party to bring or prosecute actions or suits against third parties for infringement; (iii) conferring any right to the other party to use in advertising, publicity, or otherwise, any trademark, trade name or names of either party, or any contraction, abbreviation or simulation thereof without the prior written consent of the other party; or (iv) conferring by implication, estoppel or otherwise, upon either party, any right (including a license) under other patents except for the rights expressly granted hereunder.
- 6.1.4. CONSEQUENTIAL DAMAGES. IN NO EVENT SHALL EITHER PARTY BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND, INCLUDING BUT NOT LIMITED TO, LOSS OF PROFITS OR DAMAGES TO A PARTY'S BUSINESS REPUTATION HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN AN ACTION FOR CONTRACT, INFRINGEMENT, STRICT LIABILITY OR TORT (INCLUDING NEGLIGENCE) OR OTHERWISE, WHETHER OR NOT A PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND NOTWITHSTANDING THE FAILURE OF ESSENTIAL PURPOSE OF ANY REMEDY.
- 6.2. Confidentiality. From and after the Effective Date, neither party shall disclose the terms of this Agreement except:
- 6.2.1. with the prior written consent of the other party;
 - 6.2.2. to any governmental body having jurisdiction and specifically requiring such disclosure;
 - 6.2.3. in response to a valid subpoena or as otherwise may be required by law;
 - 6.2.4. for the purposes of disclosure in connection with the Securities and Exchange Act of 1934, as amended, the Securities Act of 1933, as amended, and any other reports filed with the Securities and Exchange Commission, or any other filings, reports or disclosures that may be required under applicable laws or regulations;
 - 6.2.5. to a party's accountants, legal counsel, tax advisors and other financial and legal advisors, subject to obligations of confidentiality and/or privilege at least as stringent as those contained herein;
 - 6.2.6. as required during the course of litigation and subject to protective order; provided however, that any production under a protective order would be protected under an "Attorneys Eyes Only" or higher confidentiality designation; or
 - 6.2.7. with obligations of confidentiality at least as stringent as those contained herein, to a counterparty in connection with a proposed merger, acquisition, financing or similar transaction and/or in order to comply with the provisions of Section 3.4 above, provided that in such circumstances only a legal brief will be given;

provided, however, that prior to any such disclosure pursuant to paragraphs 6.2.2, 6.2.3, 6.2.4 and 6.2.6 hereof, the party seeking disclosure shall promptly notify the other party and take all reasonable actions in an effort to minimize the nature and extent of such disclosure. In furtherance hereof, Defendant will direct its counsel to promptly return to Plaintiff counsel any documents provided to Defendant or its counsel by Plaintiff or its counsel. Parties agree that due to SC's current financial conditions, it needs to advise Tokyo Stock Exchange of 1) fact of the settlement, 2) opposing party (name and address), and 3) amount of payment, for its public inspection.

- 6.3. Notices. All notices required or permitted to be given hereunder shall be in writing and shall be delivered by hand, or, if dispatched by prepaid air courier, with package tracing capabilities or by registered or certified airmail, postage prepaid, addressed as follows:

If to Plaintiff:

John Lee
Banie & Ishimoto LLP
3705 Have Ave. #137
Menlo Park, CA 94025

If to Defendant:

Kevin A. Fox
Sharp Electronics Corporation
Office of the General Counsel
100 Paragon Drive
Montvale, NJ 07465


Such notices shall be deemed to have been served when received by addressee. Either party may give written notice of a change of address and, after notice of such change has been received, any notice or request shall thereafter be given to such party as above provided at such changed address.

- 6.4. Publicity. Neither party will issue a press release or any other announcement regarding this Agreement or the relationship contemplated herein unless both parties provide prior consent in writing. The parties shall direct their representatives not to make any disclosures of the terms of this Agreement. Notwithstanding the foregoing and Section 6.2 above, (i) upon inquiry either party may state that Plaintiff and Defendant have entered into a patents in suit settlement agreement and (ii) Plaintiff may make the following statements: "Sharp Electronics Corporation has licensed certain Lone Star Technological Innovations, LLC patents."
- 6.5. Governing Law / Jurisdiction. This Agreement and matters connected with the performance thereof shall be construed, interpreted, applied and governed in all respects in accordance with the laws of the United States of America and the State of Texas, without reference to conflict of laws principles. Plaintiff and Defendant agree (a) that all disputes and litigation regarding this Agreement, its construction and matters connected with its performance be subject to the exclusive jurisdiction of the state and federal courts in the Eastern District of Texas, located in Tyler, Texas (the "Court"), and (b) to submit any disputes, matters of interpretation, or enforcement actions arising with respect to the subject matter of this Agreement exclusively to the Court. The parties hereby waive any challenge to the jurisdiction or venue of the Court over these matters.
- 6.6. Sophisticated Parties Represented by Counsel. The parties each acknowledge, accept, warrant and represent that (i) they are sophisticated parties represented at all relevant times during the negotiation and execution of this Agreement by counsel of their choice, and that they have executed this Agreement with the consent and on the advice of such independent legal counsel, and (ii) they and their counsel have determined through independent investigation and robust, arm's-length negotiation that the terms of this Agreement shall exclusively embody and govern the subject matter of this Agreement.
- 6.7. Bankruptcy. Each party irrevocably waives all arguments and defenses arising under 11 U.S.C. 365(c)(1) or successor provisions to the effect that applicable law excuses the party, other than the debtor, from accepting performance from or rendering performance to an entity other than the debtor or debtor in possession as a basis for opposing assumption of the Agreements by the other party in a case under Chapter 11 of the Bankruptcy Code to the extent that such consent is required under 11 U.S.C. § 365(c)(1) or any successor statute. Any change of control resulting from any such bankruptcy proceeding shall remain subject to Section 5 above.


- 6.8. Severability. If any provision of this Agreement is held to be illegal or unenforceable, such provision shall be limited or eliminated to the minimum extent necessary so that the remainder of this Agreement will continue in full force and effect and be enforceable. The parties agree to negotiate in good faith and to enforce a substitute provision for any invalid or unenforceable provision that most nearly achieves the intent of such provision.
- 6.9. Entire Agreement. The parties acknowledge, accept, warrant and represent that (i) this is an enforceable agreement; (ii) this Agreement embodies the entire and only understanding of each of them with respect to the subject matter of the Agreement, and merges, supersedes and cancels all previous representations, warranties, assurances, conditions, definitions, understandings or any other statement, express, implied, or arising by operation of law, whether oral or written, whether by omission or commission between and among them with respect to the subject matter of the Agreement; (iii) no oral explanation or oral information by either party hereto shall alter the meaning or interpretation of this Agreement; (iv) the terms and conditions of this Agreement may be altered, modified, changed or amended only by a written agreement executed by duly authorized representatives of Plaintiff and Defendant, (v) the language of this Agreement has been approved by counsel for each of them, and shall be construed as a whole according to its fair meaning, and (vi) none of them (nor their respective counsel) shall be deemed to be the draftsman of this Agreement in any action which may hereafter arise with respect to the Agreement.
- 6.10. Modification; Waiver. No modification or amendment to this Agreement, nor any waiver of any rights, will be effective unless assented to in writing by the party to be charged, and the waiver of any breach or default will not constitute a waiver of any other right hereunder or any subsequent breach or default.
- 6.11. Construction; Language. Any rule of construction to the effect that ambiguities are to be resolved against the drafting party will not be applied in the construction or interpretation of this Agreement. As used in this Agreement, the words "include" and "including" and variations thereof, will not be deemed to be terms of limitation, but rather will be deemed to be followed by the words "without limitation." The headings in this Agreement will not be referred to in connection with the construction or interpretation of this Agreement. This Agreement is in the English language only, which language shall be controlling in all respects, and all notices under this Agreement shall be in the English language.
- 6.12. Counterparts. This Agreement may be executed in counterparts or duplicate originals, both of which shall be regarded as one and the same instrument, and which shall be the official and governing version in the interpretation of this Agreement. This Agreement may be executed by facsimile signatures or other electronic means and such signatures shall be deemed to bind each party as if they were original signatures.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be signed below by their respective duly authorized officers.

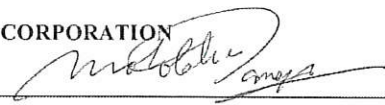
Lone Star Technological Innovations, LLC

By: 
Name: Bradley D. Liddle
Title: General Counsel

SHARP ELECTRONICS CORPORATION

By: 
Name: KEVIN A. FOX
Title: SVP, General Counsel + Corporate Sec'y

SHARP CORPORATION

By: 
Name: Mototaka Taneya
Title: Managing Officer, BU President,
Corporate R&D BU

HIGHLY CONFIDENTIAL RULE 408 COMMUNICATION

EXHIBIT A

STIPULATED MOTION FOR DISMISSAL WITH PREJUDICE

The Plaintiff, Lone Star Technological Innovations, LLC and Defendant Sharp Electronics Corporation pursuant to Fed. R. Civ. P. 41(a)(2) and (c), hereby move for an order dismissing all claims and counterclaims in this action WITH PREJUDICE, subject to the terms of that certain agreement entitled "**PATENT LICENSE AND SETTLEMENT AGREEMENT**" and dated December __, 2016, with each party to bear its own costs, expenses and attorneys' fees.

ORDER OF DISMISSAL WITH PREJUDICE

CAME ON THIS DAY for consideration of the Stipulated Motion for Dismissal With Prejudice of all claims and counterclaims asserted between plaintiff, Lone Star Technological Innovations, LLC, and Defendant **Sharp Electronics Corporation**, in this case, and the Court being of the opinion that said motion should be GRANTED, it is hereby

ORDERED, ADJUDGED AND DECREED that all claims and counterclaims asserted in this suit between plaintiff, Lone Star Technological Innovations, LLC, and Defendant **Sharp Electronics Corporation**, are hereby dismissed with prejudice, subject to the terms of that certain agreement entitled "**PATENT LICENSE AND SETTLEMENT AGREEMENT**" and dated December __, 2016.

It is further ORDERED that all attorneys' fees and costs are to be borne by the party that incurred them.

PATENT LICENSE AND SETTLEMENT AGREEMENT

This PATENT LICENSE AND SETTLEMENT AGREEMENT (this “Agreement”) is made and entered into as of December 23, 2020 (the “Effective Date”) by and between Plaintiff Lone Star Technological Innovations, LLC, a limited liability company organized and existing under the laws of the State of Texas, having a principal place of business at 1999 Bryan Street, Suite 900, Dallas, Texas, 75201 (“Plaintiff”); and Barco NV, having a principal place of business at Beneluxpark 21 Kortrijk Belgium 8500 (hereinafter referred to as “Barco”). Plaintiff and Barco are individually referred to herein as a “party,” and collectively as the “parties.”

WITNESSETH

WHEREAS, Plaintiff has filed an action against Barco NV, for patent infringement in an action styled *Lone Star Technological Innovations, LLC v. Barco NV*, Case No. 6:19-cv-0060, related to Plaintiff’s U.S. Patent Nos. 6,724,435 and 6,122,012 (“Patents-In-Suit”) pending in the United States District Court for the Eastern District of Texas (the “Litigation”).

WHEREAS Barco denies infringement and alleges that the Patents-in-suit are invalid and unenforceable;

WHEREAS Barco’s sales of allegedly infringing products in the United States from February 2013-February 2020 does not exceed \$212,000,000 USD.

WHEREAS, this Agreement has not been negotiated under the “Hypothetical Negotiation” standard and the parties agree this settlement does not represent a reasonable royalty as this settlement is an agreement between the parties to resolve a commercial dispute;

NOW, THEREFORE, in consideration of the above promises and mutual covenants hereinafter contained, the parties agree as follows:

1. DEFINITIONS

As used in this Agreement, the following terms shall have the following meanings:

“Affiliate” means, with respect to plaintiff, any current and future (i) subsidiary of a party or (ii) any individual, trust, corporation, partnership, joint venture, limited liability company, association, unincorporated organization or other legal entity; in each case that is controlling the party, controlled by the party, or is under common control with such party.

“Licensed Affiliate” means (i) Barco NV; and any current and future (ii) subsidiary of Barco or (iii) any individual trust, corporation, partnership, joint venture, limited liability company, association, unincorporated organization or other legal entity in each case that is controlled by Barco.

For purposes of this Agreement, “control” shall exclusively mean the ownership, directly or indirectly, of fifty percent (50%) or more of the outstanding voting shares of such an entity, or an ownership right representing more than 50% of the rights to make decisions for such an entity. Notwithstanding the foregoing, with respect to Barco, the term “Licensed Affiliates” excludes any Person that is a party to a pending patent infringement claim or lawsuit filed by Plaintiff with respect to the Licensed Patents prior to controlling, becoming controlled by, or becoming under common control with Barco.

“Licensed Products” means the products and services of or provided by Barco and/or its Licensed Affiliates which would constitute, but for the license granted to Barco herein, an infringement, as defined by 35 U.S.C 271 of any claims of any of the Licensed Patents.

“Patents” mean, (i) all classes and/or types of patents, including utility patents, utility models, design patents, invention certificates, reexaminations, reissues, extensions and renewals anywhere in the world; and (ii) all applications (including provisional and nonprovisional applications), continuations, divisionals, continuations-in-part, and rights to inventions for which applications may be filed, for these classes and/or types of patents.

“Person” means any individual, corporation, partnership, joint venture, trust, unincorporated organization, or other legal entity.

“Licensed Patents” means United States Patent Nos. 6,724,435; 6,122,012; and any divisionals, continuations, continuations-in-part, or foreign counterparts to United States Patent Nos. 6,724,435 or 6,122,012.

“Third Party” means any person or entity other than a party (including such party’s Affiliates) to this Agreement.

2. LICENSE, RELEASES AND COVENANTS

2.1. License. Subject to compliance by Barco and its Licensed Affiliates with the terms and conditions of this Agreement, Plaintiff, on behalf of itself, its Affiliates, and their respective employees, hereby grants to Barco and its Licensed Affiliates for Licensed Products a royalty-free, non-exclusive, non-sublicensable, non-transferable to Third Parties other than the Licensed Affiliate of Barco license to (i) make, have made, use, import, export, distribute, sell, offer for sale, lease, and advertise under the Licensed Patents solely with respect to the Licensed Products (ii) make, have made, use and import machines, tools, materials and other instrumentalities, insofar as such machines, tools, materials and other instrumentalities are required for the development, manufacture, testing or repair of Licensed Products which are or have been made, offered for sale, used, leased, owned, sold, exported or imported by Barco; and (iii) convey to any customer of Barco and/or its Licensed Affiliates the rights to use, offer for sale, lease, import, export, resell, transfer and otherwise dispose of such Licensed Products as sold, leased, transferred or otherwise disposed of by Barco and/or its Licensed Affiliates. For the avoidance of doubt, Section 2.1 shall not cover any Third Party products or services, except that the license grant set forth in this Section 2.1 shall include Barco’s and its Licensed Affiliates’ distributors, resellers, end users, and customers with respect to the Licensed Products.

2.2. Plaintiff Release of Barco. Subject to the payment provided under Section 3 and the compliance by Barco and its Licensed Affiliates with the terms and conditions of this Agreement, Plaintiff, on behalf of itself, its Affiliates, and their respective attorneys, insurers, agents, officers, directors and employees (“Plaintiff Releasing Party”) hereby, fully, irrevocably and forever releases, acquits, and discharges Barco and its Licensed Affiliates, and their respective officers, directors, managers, members, employees, agents, experts, consultants and attorneys (collectively, “Barco Released Parties”) from any and all claims, counterclaims, demands, losses, costs, damages, debts, liabilities, obligations and causes of action (regardless of whether they are now known or unknown, suspected or unsuspected) that the Plaintiff Releasing Party may have on account of the Barco Released Party’s acts related to: (i) any act (including but not limited to making, having made, keeping, using, leasing, selling, offering to sell, importing, exporting, transferring, or otherwise disposing) of past, present, or future infringement, direct, contributory, or by inducement of any of the Licensed Patents solely with respect to the Licensed Products; (ii) the claims and counterclaims asserted in, and the conduct of, the Litigation; and (iii) the conduct of settlement negotiations occurring before the Effective Date (except for representations and obligations expressly included in this Agreement).

2.3. Plaintiff Covenant Not to Sue Barco. Subject to the payment provided under Section 3 and compliance by Barco and its Licensed Affiliates with the terms and conditions of this Agreement, Plaintiff covenants not to bring or prosecute any judicial, administrative, or other proceedings of any kind, anywhere in the world, against Barco for any claim under any Licensed Patents or any claim relating to, based upon, or arising under any Licensed Patents during the period of ten (10) years from the Effective Date (“Covenant Period”). For the avoidance of doubt, this Covenant shall not cover any Third Party products or services. Plaintiff further covenants not to sue Barco, its customers, licensees, depositors, end-users, suppliers, vendors, manufacturers, hosts, partners, distributors, contractors, or developers, for actual or alleged infringement of any Patents. For the avoidance of doubt, Covenant Not to Sue means that should any claim be brought against Barco following the Covenant Period, no damages or other remedies shall be available or recoverable against Barco prior to the expiration of the Covenant Period.

- 2.4. Barco Release of Plaintiff. Subject to Plaintiff's compliance with the terms and conditions of this Agreement, Barco, on behalf of the Barco Released Parties, releases Plaintiff, its Affiliates and the Plaintiff Releasing Party from any and all claims, counterclaims, demands, losses, costs, damages, debts, liabilities, obligations and causes of action (regardless of whether they are now known or unknown, suspected or unsuspected) that the Barco Released Parties may have on account of: (i) the Licensed Patents; (ii) the claims and counterclaims asserted or which could have been asserted in, and the conduct of, the Litigation; and (iii) the conduct of settlement negotiations occurring before the Effective Date (except for representations and obligations expressly included in this Agreement).
- 2.5. Barco Covenant Not to Sue Plaintiff. Subject to Plaintiff's compliance with the terms and conditions of this Agreement, Barco, on behalf of itself and its Licensed Affiliates, covenants not to sue Plaintiff or its Affiliates for any claims related to the Licensed Patents. Barco further covenants, represents and warrants that it shall not contest or assist in the contest in any forum, including Federal Courts, whether under 28 U.S.C. §§ 2201-2202 or not, the United States Patent and Trademark Office, and/or the International Trade Commission, that the Licensed Patents are valid and enforceable. Barco reserves the right to contest the validity and enforceability of the Licensed Patents solely to the extent a claim of infringement under the Licensed Patents is brought against a Barco Released Party with respect to the Licensed Products. It is hereby agreed that complying with the requirements of law to provide information requested or demanded by a Third Party (e.g., a subpoena or a discovery request for document production) shall not be deemed a violation of this Section 2.5.
- 2.6. No Other Rights / No Exhaustion. No rights or covenants are granted under any patents except as expressly provided herein, whether by implication, estoppel or otherwise. Except as otherwise expressly granted in this Agreement, no right to grant covenants, rights, sublicenses or to become a foundry for Third Parties is granted under this Agreement.
- 2.7. Releases. The releases in this Agreement include an express, informed, knowing and voluntary waiver and relinquishment to the fullest extent permitted by law. In this connection, the parties acknowledge that they may have sustained damages, losses, costs or expenses which are presently unknown and unsuspected and that such damages, losses, costs or expenses as may have been sustained may give rise to additional damages, losses, costs or expenses in the future. The parties hereto further acknowledge that they have negotiated this Agreement taking into account presently unsuspected and unknown claims, counterclaims, causes of action, damages, losses, costs and expenses, and the parties hereto voluntarily and with full knowledge of its significance, expressly waive and relinquish any and all rights they may have under any state or federal statute, rule or common law principle, in law or equity, relating to limitations on general releases. The parties voluntarily and with full knowledge of its significance, expressly waive and relinquish any and all rights they may have under any state or federal statute, rule or common law principle, in law or equity, relating to limitations on releases. Specifically, each party hereby expressly waives any rights it may have under California Civil Code Section 1542 (or any other similar law in any jurisdiction) which provides that: **"A general release does not extend to claims which the creditor does not know or suspect to exist in his favor at the time of executing the release, which if known by him must have materially affected his settlement with the debtor."**
- 2.8. Termination of Litigation. No later than five (5) business days after receipt of Payment by Plaintiff, set forth in section 3.1, or such time as required by the Court, the Parties shall request dismissal of the Litigation with prejudice by filing the form of dismissal attached hereto as Exhibit A, or by such other procedure as agreed to between the Parties or which may be reasonably necessary to dismiss the Litigation with prejudice.

3. ADDITIONAL CONSIDERATION

- 3.1. Payment. In consideration of the release and covenant granted by Plaintiff and the dismissal by Plaintiff of the Litigation hereunder in addition to all other consideration provided for in this Agreement, Barco agrees to deliver via wire transfer a total of One Hundred Thirty Five Thousand U.S. Dollars (\$135,000), payable in one

cash payment by Barco to Plaintiff no later than thirty (30) Days after the later of (a) the last signature date of this Agreement, to the following account:

Banie & Ishimoto LLP Wells Fargo Trust Account

Account Number: [REDACTED]

Routing Numbers

Direct Deposits: [REDACTED]

Wire Transfers – Domestic: [REDACTED]

Swift Code for Transfers: WFBIUS6S

- 3.2. Taxes / Costs. The payment required by this Agreement shall not be reduced by Barco for any taxes, levies, imposts, customs, duties, fees or similar charges imposed by any governmental authority of any nature including sales or use tax, excise tax, stamp tax or duty, any withholding or back up withholding tax and value added tax, except for tax imposed on Plaintiff in a jurisdiction outside the United States if and only to the extent such tax is allowable as a credit against the United States income taxes of Plaintiff. Each Party agrees to bear and be responsible for the payment of any taxes (including income taxes), levies, imposts, customs, duties, fees and charges that may be levied or assessed on it in connection with this Agreement. Barco will not deduct or withhold any amounts from the payment to Plaintiff required under Section 3.1 of this Agreement. The parties agree that they will bear their own costs and attorneys' fees relating to or arising from the Litigation and to the negotiation of this Agreement. Specifically, Plaintiff will be responsible for any taxes to which it is subject as a result of the payment made by Barco to Plaintiff in accordance with Section 3.1 under this Agreement. Plaintiff acknowledges that the payment by Barco to Plaintiff of the amount due under Article 3 may be subject to certain withholding tax requirements. Each Party shall use commercially reasonable efforts to complete all tax forms and other documents required by applicable tax authorities and to provide the other Parties with any document required, in a timely manner, in order to avoid or minimize withholdings from any payments due under this Agreement or to claim the benefit of any favorable withholding rates under applicable tax treaties.
- 3.3. Stand Still of the Litigation and Dismissal. Immediately following the execution of this Agreement, the Parties shall jointly advise the court presiding over the Litigation on a confidential basis that such action is pending settlement and that, subject to the terms and satisfaction of conditions of a confidential Agreement between the Parties and payment of the monetary consideration under Section 3.1, a motion to dismiss will be filed. The Parties shall also request, if applicable, that all outstanding deadlines in any procedural schedule be stayed or suspended pending dismissal. Within five (5) court days after the payment of the consideration to Plaintiff under this Section 3, the parties shall cause their respective counsel to execute and file the stipulated motion in the form set forth in Exhibit A dismissing with prejudice all claims and counterclaims between the parties in the Litigation. The parties shall promptly proceed with any and all additional procedures needed to dismiss with prejudice the Litigation. The parties acknowledge and agree that this Agreement is enforceable according to its terms with respect to final dismissal with prejudice of all claims and counterclaims in the Litigation.
- 3.4. The amount in Section 3.1 shall be nonrefundable under any and all circumstances, including but not limited to the Licensed Patents being held invalid or unenforceable.

4. TERM AND TERMINATION

- 4.1. Term. The term of this Agreement shall commence upon the Effective Date and shall continue until the expiration of the last-to-expire of the Licensed Patents, unless earlier terminated by Plaintiff as set forth below.

5. ASSIGNMENT

- 5.1. No Assignment. Except as set forth below, neither party may assign (by contract, operation of law or otherwise) its rights under this Agreement without the prior written consent of the other and any attempt to assign without such permission will be void.

(a) Permitted Assignment by Barco. Barco may assign its rights under this Agreement, in whole or in part, without Plaintiff's prior written consent: (i) as part of a merger (in which it is not the surviving entity) with, or sale of all or substantially all of its assets or shares of Barco or all or substantially all of Barco's assets or shares of any business unit or product line concerning or relating to the Licensed Products, to a Third Party acquirer (an "Acquirer"), provided that (a) the Acquirer is not a party to a written communication by Plaintiff asserting a patent infringement claim or lawsuit filed by Plaintiff with respect to one or more of the Licensed Patents and pending at the time Barco conducts such sale, transfer or spin-off; and (b) the rights of Barco hereunder so assigned, including any licenses, releases and covenants not to sue only extend to (aa) Licensed Products existing as of the date of such sale, transfer or spin-off; or (bb) any improvement, upgrades updates to (aa); or (cc) Licensed Products to be made, had made, sold, offered for sale according to the product road map of Barco, which product road map was in existence prior to the assignment, as supported by Barco's written evidence; and will not extend to any other products, services or activities, including those of the Acquirer or any of its Affiliates. In addition to the foregoing, all releases and covenants of Barco and its Licensed Affiliates contained herein shall run with the rights of Barco being assigned or transferred and shall be binding on any successors-in-interest, transferees, or assigns thereof. Barco shall not assign or otherwise transfer any right hereunder to any other party unless (i) such sale or assignment is subject to all of the terms and conditions of this Agreement, and (ii) such other party executes an agreement agreeing to be bound by all of the terms and conditions of this Agreement with respect to the rights being transferred or assigned.

(b) Permitted Assignment by Plaintiff. Notwithstanding the provisions of Section 5.1, Plaintiff shall be permitted to assign this Agreement to an Affiliate.

- 5.2. All rights, releases, licenses and covenants contained herein shall run with the Licensed Patents and shall be binding on any successors-in-interest, assigns thereof, or exclusive licensees. Plaintiff and its Affiliates shall not assign, sell, exclusively license or otherwise transfer or grant any ownership right or right to enforce or recover under any of Licensed Patents to any other party without the same being subject to the rights, covenants, licenses and releases provided by Plaintiff or Plaintiff's Affiliate under this Agreement. Subject to the foregoing, this Agreement shall be binding upon and inure to the benefit of the Parties and their permitted successors and assigns.

6. MISCELLANEOUS PROVISIONS

6.1. Representations:

6.1.1. Plaintiff Representations: Plaintiff represents and warrants, with respect to the Licensed Patents only, as of the Effective Date that: (i) Plaintiff, on behalf of itself and its Affiliates, owns and/or controls the Licensed Patents, and has the sufficient right, title and interest to grant the license, releases and covenants with respect to the Licensed Patents of the full scope set forth herein; (ii) it has not assigned or otherwise transferred to any other Person any rights to the Licensed Patents that would prevent Plaintiff from entering into this Agreement; (iii) the person executing this Agreement on behalf of Plaintiff has the full right and authority to enter into this Agreement on Plaintiff's behalf and Plaintiff has the authority to enter into this Agreement; and (iv) Plaintiff is an LLC in good standing under the laws of the state of Texas. Plaintiff further represents and warrants that it understands that it is has exclusively negotiated and is contracting with Barco, and acknowledges it is not contracting (directly or indirectly, by any legal theory or otherwise) with any other Person or any Third Party and no Person other than Plaintiff and Barco are parties to this Agreement (directly or indirectly, by implication or under any legal theory or otherwise).

6.1.2. Barco Representations: Barco represents and warrants as of the Effective Date that: (i) Barco has the right to grant the releases and covenants of the full scope set forth herein and (ii) the person executing

this Agreement on behalf of Barco has the full right and authority to enter into this Agreement on Barco's behalf. Barco further represents and warrants that it understands that it is has exclusively negotiated and is contracting with Plaintiff, and acknowledges it is not contracting (directly or indirectly, by any legal theory or otherwise) with any other Person or any Third Party and no Person other than Plaintiff and Barco are parties to this Agreement (directly or indirectly, by implication or under any legal theory or otherwise).

- 6.1.3. No Warranties. Unless otherwise expressly stated in this Agreement, nothing contained in this Agreement shall be construed as: (i) a warranty or representation by either party that any manufacture, sale, use or other disposition of products by the other party has been or will be free from infringement of any patents; (ii) an agreement by either party to bring or prosecute actions or suits against third parties for infringement, or conferring any right to the other party to bring or prosecute actions or suits against third parties for infringement; (iii) conferring any right to the other party to use in advertising, publicity, or otherwise, any trademark, trade name or names of either party, or any contraction, abbreviation or simulation thereof without the prior written consent of the other party; or (iv) conferring by implication, estoppel or otherwise, upon either party, any right (including a license) under other patents except for the rights expressly granted hereunder.
- 6.1.4. CONSEQUENTIAL DAMAGES. IN NO EVENT SHALL EITHER PARTY BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND, INCLUDING BUT NOT LIMITED TO, LOSS OF PROFITS OR DAMAGES TO A PARTY'S BUSINESS REPUTATION HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN AN ACTION FOR CONTRACT, INFRINGEMENT, STRICT LIABILITY OR TORT (INCLUDING NEGLIGENCE) OR OTHERWISE, WHETHER OR NOT A PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND NOTWITHSTANDING THE FAILURE OF ESSENTIAL PURPOSE OF ANY REMEDY.
- 6.2. Confidentiality. From and after the Effective Date, neither party shall disclose the terms of this Agreement except:
- 6.2.1. with the prior written consent of the other party;
 - 6.2.2. to any governmental body having jurisdiction and specifically requiring such disclosure;
 - 6.2.3. in response to a valid subpoena or as otherwise may be required by law;
 - 6.2.4. for the purposes of disclosure in connection with the Securities and Exchange Act of 1934, as amended, the Securities Act of 1933, as amended, and any other reports filed with the Securities and Exchange Commission, or any other filings, reports or disclosures that may be required under applicable laws or regulations;
 - 6.2.5. to a party's accountants, legal counsel, tax advisors and other financial and legal advisors, subject to obligations of confidentiality and/or privilege at least as stringent as those contained herein;
 - 6.2.6. as required during the course of litigation and subject to protective order; provided however, that any production under a protective order would be protected under an "Attorneys Eyes Only" or higher confidentiality designation;
 - 6.2.7. with obligations of confidentiality at least as stringent as those contained herein, to a counterparty in connection with a proposed merger, acquisition, financing or similar transaction and/or in order to comply with the provisions of Section 3.4 above, provided that in such circumstances only a legal brief will be given; or
 - 6.2.8. to any person or entity if such disclosure is made pursuant to an executed non-disclosure agreement whereby the individual(s) or entity(-ies) to whom disclosure is made agrees in writing, prior to any such

disclosure, to not further disclose this Patent Agreement or any of the information contained therein to any other person or entity without first obtaining the express written consent of Lone Star and Barco.

provided, however, that prior to any such disclosure pursuant to paragraphs 6.2.2, 6.2.3, 6.2.4 and 6.2.6 hereof, the party seeking disclosure shall promptly notify the other party and take all reasonable actions in an effort to minimize the nature and extent of such disclosure. In furtherance hereof, Barco will direct its counsel to promptly return to Plaintiff counsel any documents provided to Barco or its counsel by Plaintiff or its counsel.

- 6.3. Notices. All notices required or permitted to be given hereunder shall be in writing and shall be delivered by hand, or, if dispatched by prepaid air courier, with package tracing capabilities or by registered or certified airmail, postage prepaid, addressed as follows:

If to Plaintiff:

John Lee
Banie & Ishimoto LLP
2100 Geng Road, Suite 210
Palo Alto, CA 94303

If to Barco:

Barco NV
Attn: General Counsel
Beneluxpark 21
Kortrijk Belgium 8500

Barco, Inc.
Attn: Legal Department
3059 Premiere Parkway, Suite 400
Duluth, GA 30097

INSERT

Such notices shall be deemed to have been served when received by addressee. Either party may give written notice of a change of address and, after notice of such change has been received, any notice or request shall thereafter be given to such party as above provided at such changed address.

- 6.4. Publicity. Neither party will issue a press release or any other announcement regarding this Agreement or the relationship contemplated herein unless both parties provide prior consent in writing. The parties shall direct their representatives not to make any disclosures of the terms of this Agreement. Notwithstanding the foregoing and Section 6.2 above, (i) upon inquiry either party may state that Plaintiff and Barco have entered into a settlement agreement regarding the Licensed Patents, and (ii) Plaintiff may make the following statements: "Barco has licensed certain Lone Star Technological Innovations, LLC patents."
- 6.5. Governing Law / Jurisdiction. This Agreement and matters connected with the performance thereof shall be construed, interpreted, applied and governed in all respects in accordance with the laws of the United States of America and the State of Texas, without reference to conflict of laws principles. Plaintiff and Barco agree (a) that all disputes and litigation regarding this Agreement, its construction and matters connected with its performance be subject to the exclusive jurisdiction of the state and federal courts in the Eastern District of Texas, located in Tyler, Texas (the "Court"), and (b) to submit any disputes, matters of interpretation, or enforcement actions arising with respect to the subject matter of this Agreement exclusively to the Court. The parties hereby waive any challenge to the jurisdiction or venue of the Court over these matters.
- 6.6. Sophisticated Parties Represented by Counsel. The parties each acknowledge, accept, warrant and represent that (i) they are sophisticated parties represented at all relevant times during the negotiation and execution of

this Agreement by counsel of their choice, and that they have executed this Agreement with the consent and on the advice of such independent legal counsel, and (ii) they and their counsel have determined through independent investigation and robust, arm's-length negotiation that the terms of this Agreement shall exclusively embody and govern the subject matter of this Agreement.

- 6.7. Bankruptcy. Each party irrevocably waives all arguments and defenses arising under 11 U.S.C. 365(c)(1) or successor provisions to the effect that applicable law excuses the party, other than the debtor, from accepting performance from or rendering performance to an entity other than the debtor or debtor in possession as a basis for opposing assumption of the Agreements by the other party in a case under Chapter 11 of the Bankruptcy Code to the extent that such consent is required under 11 U.S.C. § 365(c)(1) or any successor statute. Any change of control resulting from any such bankruptcy proceeding shall remain subject to Section 5 above.
- 6.8. Severability. If any provision of this Agreement is held to be illegal or unenforceable, such provision shall be limited or eliminated to the minimum extent necessary so that the remainder of this Agreement will continue in full force and effect and be enforceable. The parties agree to negotiate in good faith and to enforce a substitute provision for any invalid or unenforceable provision that most nearly achieves the intent of such provision.
- 6.9. Entire Agreement. The parties acknowledge, accept, warrant and represent that (i) this is an enforceable agreement; (ii) this Agreement embodies the entire and only understanding of each of them with respect to the subject matter of the Agreement, and merges, supersedes and cancels all previous representations, warranties, assurances, conditions, definitions, understandings or any other statement, express, implied, or arising by operation of law, whether oral or written, whether by omission or commission between and among them with respect to the subject matter of the Agreement; (iii) no oral explanation or oral information by either party hereto shall alter the meaning or interpretation of this Agreement; (iv) the terms and conditions of this Agreement may be altered, modified, changed or amended only by a written agreement executed by duly authorized representatives of Plaintiff and Barco, (v) the language of this Agreement has been approved by counsel for each of them, and shall be construed as a whole according to its fair meaning, and (vi) none of them (nor their respective counsel) shall be deemed to be the draftsman of this Agreement in any action which may hereafter arise with respect to the Agreement.
- 6.10. Modification; Waiver. No modification or amendment to this Agreement, nor any waiver of any rights, will be effective unless assented to in writing by the party to be charged, and the waiver of any breach or default will not constitute a waiver of any other right hereunder or any subsequent breach or default.
- 6.11. Construction; Language. Any rule of construction to the effect that ambiguities are to be resolved against the drafting party will not be applied in the construction or interpretation of this Agreement. As used in this Agreement, the words "include" and "including" and variations thereof, will not be deemed to be terms of limitation, but rather will be deemed to be followed by the words "without limitation." The headings in this Agreement will not be referred to in connection with the construction or interpretation of this Agreement. This Agreement is in the English language only, which language shall be controlling in all respects, and all notices under this Agreement shall be in the English language.
- 6.12. Counterparts. This Agreement may be executed in counterparts or duplicate originals, both of which shall be regarded as one and the same instrument, and which shall be the official and governing version in the interpretation of this Agreement. This Agreement may be executed by facsimile signatures or other electronic means and such signatures shall be deemed to bind each party as if they were original signatures.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be signed below by their respective duly authorized officers.

LONE STAR TECHNOLOGICAL INNOVATIONS, LLC

By: Jesse Rice 1/8/2021

Name: Jesse Rice

Title: Managing Director

BARCO NV

By: [Signature] 1/11/2021

Name: KURT VERHEGGEN

Title: GENERAL COUNSEL

HIGHLY CONFIDENTIAL RULE 408
COMMUNICATION

EXHIBIT A

STIPULATED MOTION FOR DISMISSAL WITH PREJUDICE

The Plaintiff, Lone Star Technological Innovations, LLC and Barco NV pursuant to Fed. R. Civ. P. 41(a)(2) and (c), hereby move for an order dismissing all claims and counterclaims in this action WITH PREJUDICE, subject to the terms of that certain agreement entitled “**PATENT LICENSE AND SETTLEMENT AGREEMENT**” and dated December ____, 2020, with each party to bear its own costs, expenses and attorneys’ fees.

ORDER OF DISMISSAL WITH PREJUDICE

CAME ON THIS DAY for consideration of the Stipulated Motion for Dismissal With Prejudice of all claims and counterclaims asserted between plaintiff, Lone Star Technological Innovations, LLC, and Barco NV, in this case, and the Court being of the opinion that said motion should be GRANTED, it is hereby

ORDERED, ADJUDGED AND DECREED that all claims and counterclaims asserted in this suit between plaintiff, Lone Star Technological Innovations, LLC, and Barco NV, are hereby dismissed with prejudice, subject to the terms of that certain agreement entitled “**PATENT LICENSE AND SETTLEMENT AGREEMENT**” and dated December ____, 2020.

It is further ORDERED that all attorneys’ fees and costs are to be borne by the party that incurred them.

ProArt Display PA328Q

[Overview](#) [Tech Specs](#) [Review](#) [Support](#)

ASUS
ProArt
PA328Q
Professional
Monitor -
32" 4K
UHD(3840
x 2160), IPS,
Color
Accuracy
 $\Delta E < 2$,
Flicker free



- Professional-grade 32-inch 4K/UHD display with four times the pixel density of Full HD displays.
- Factory pre-calibrated, industry-leading color accuracy with 100% sRGB and Rec. 709 color space support.
- Extensive connectivity with HDMI, DisplayPort 1.2, and MHL 3.0 for smooth 4K/UHD content playback.
- ASUS Eye Care Technology with



TÜV Rheinland-certified Flicker-free technology which eliminates onscreen flicker

[Compare](#)

- Adjust for maximum comfort with ergonomic tilt, swivel, pivot and height adjustments plus wall-mount capability. PA328Q is a recipient of a 2014 Red Dot Award for its outstanding design.

PA328Q 4K UHD Color Pre-calibrated Monitor

Discover the Finest Details and True Color in 4K





Impeccable 4K/UHD Visuals

32-inch Expansive



Truly Expressive Color

100% sRGB Rec. 709 Col



ensive Connectivity with HDMI2.0

User-friendly I



Eye-care Technology

Extraordinary Com

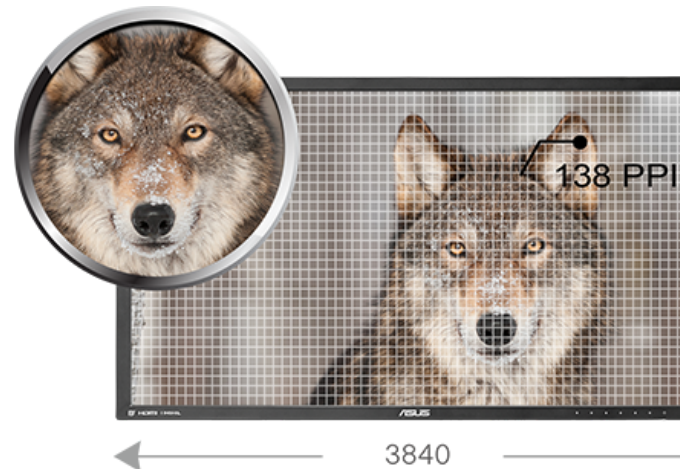
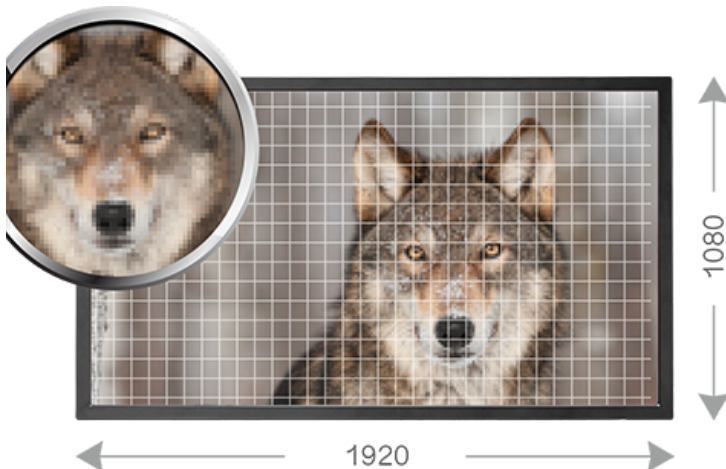
T, ACCURATE COLORS AND EXCEPTIONAL IMAGES

360° Product View



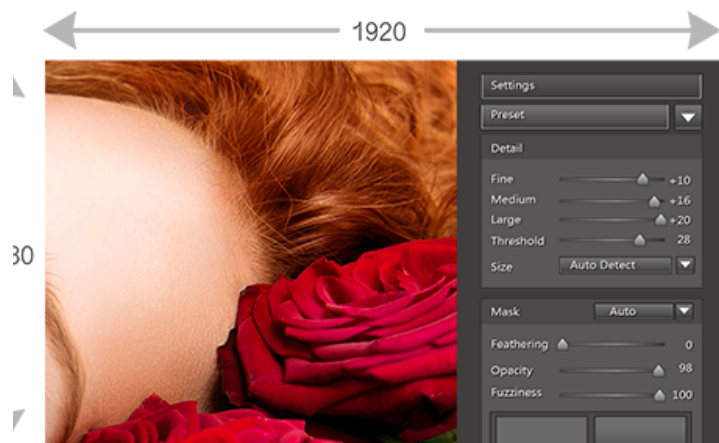
Impeccable 4K/UHD visuals

Open your eyes to breathtaking levels of detail with the ASUS PA328Q true 4K ultra-high definition (4K/UHD) monitor. It features a super-narrow bezel design and a 16:9 aspect, 32-inch panel to give you stunning visuals in resolutions of up to 3840 x 2160.



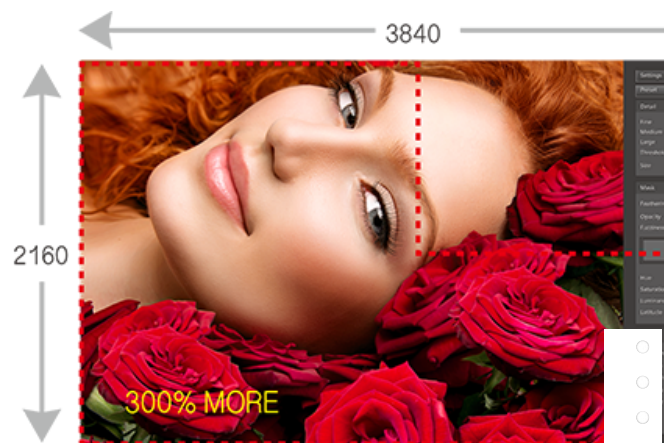
Enjoy an expansive workspace

PA328Q gives you 300% more onscreen space to work with than similarly-sized Full HD displays, allowing you to spread your various work windows for more productive multitasking.



Conventional Full HD Monitor

Less detailed and shows just part of the work sidebar. Images are also not as sharp as those seen on a 4K/UHD.



ASUS PA328Q 4K/UHD Monitor

Shows incredible detail and the entire work sidebar are much more crisp and detailed.

you in truly expressive color

ues thanks to accurate, true-to-life color reproduction. Each PA328Q monitor is factory pre-calibrated to guarantee inc e accurately reproduced onscreen, allowing you to see exactly how your work is going to look when it's finished.

ith 91 - 103% Uniformity Compensation to guard against brightness and chroma (color) fluctuations on different parts

and Rec. 709 color space support for vibrant images

of beautiful blue skies and lush green forests through a wide-view angle In-plane Switching Technology display with 3500:1 Contrast Ratio. The PA328Q features supports 100% sRGB color space, as well as Rec. 709 color space for video playback to display over one billion colors. It uses a 12-bit internal lookup table (LUT) and supports Gamma values of 2.4, 2.2 and 2.0 for smoother transitions between hues. It also features 6-axis color control with 6-axis color adjustment, so you can adjust red, green, blue, cyan, magenta and yellow.

Smooth 4K/UHD content playback

Enjoy stunning 4K/UHD visuals with the PA328Q. It is equipped with DisplayPort 1.2, mini-DisplayPort 1.2, two HDMI ports and USB-C*. PA328Q supports 4K/UHD content playback at 60Hz through HDMI-1 port or DisplayPort 1.2, and 30Hz through mini-DisplayPort 1.2 or MHL 3.0. With a 6ms gray-to-gray response time, the PA328Q gives you smooth video playback and enhanced visual play.

Supports 4K/UHD playback at 60Hz and the YCbCr 4:2:0 color format. HDMI 2.0 and MHL 3.0 ports support 4K/UHD playback at 30Hz. HDMI 2.0 and USB-C port both provide HDCP 2.2 copy protection.



ndly features

and work smarter with ASUS QuickFit Virtual Scale. PA328Q provides you with an onscreen grid overlay so you can align

<https://www.asus.com/us/Displays-Desktops/Monitors/ProArt/ProArt-Display-PA328Q/>

their actual sizes prior to printing.

Also an intuitive 5-way navigation joystick so you can easily access and switch OSD settings on the onscreen menu.

-
-
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Tired eyes with ASUS Eye Care technology

After countless hours working on a project, it's important to have a display with Flicker-free and Low Blue Light technology to say goodbye to tired eyes with ASUS Eye Care technology.

The display has passed stringent performance tests and is certified flicker-free by TÜV Rheinland laboratories, a global provider of technical, safety, and performance testing services.



Red Dot Award-winning ergonomic

viewing position is always within reach with the PA328Q. With a slim profile and ergonomically-designed stand with tilt, and height adjustments, the PA328Q provides you with a comfortable viewing angle. It's versatile too, the ability to rotate 90 degrees for use in Portrait mode comes in handy when working with websites or long documents. PA328Q is a recipient of 2014 Red Dot Award for its outstanding design



Height adjustment (0~130mm)



Swivel (+60° ~ -60°)





Tilt (+20° ~ -5°)



Pivot (90° clockwise)



- Products certified by the Federal Communications Commission and Industry Canada will be distributed in the United States and Canada. Please visit the ASUS USA and ASUS Canada websites for information about locally available products.
- All specifications are subject to change without notice. Please check with your supplier for exact offers. Products may not be available in all markets.
- Specifications and features vary by model, and all images are illustrative. Please refer to specification pages for full details.
- PCB color and bundled software versions are subject to change without notice.
- Brand and product names mentioned are trademarks of their respective companies.
- The terms HDMI and HDMI High-Definition Multimedia Interface, and the HDMI Logo are trademarks or registered trademarks of HDMI Licensing Administrator, Inc. in the United States and other countries.

Displays / Desktops

Monitors

ProArt

ProArt Display PA328Q

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Wearable

Laptops

For Home

For Work

For Creators

For Students

For Gaming

Displays / Desktops

Monitors

Projectors

All-in-One PCs

Gaming Tower PCs

Tower PCs

Mini PCs

Workstations

Motherboards / Components

Motherboards

Gaming Case

Cooling

Graphics Cards

External Graphics Docks

Power Supply Units

Sound Cards

Optical Drives

Networking / IoT / Servers

WiFi Routers

Whole Home Mesh WiFi System

Servers

Accessories

Keyboards

Mice and Mouse Pads

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FAQ

[ProArt Display] What is 6-axis color control ?

Last Update : 2020/03/16 14:50



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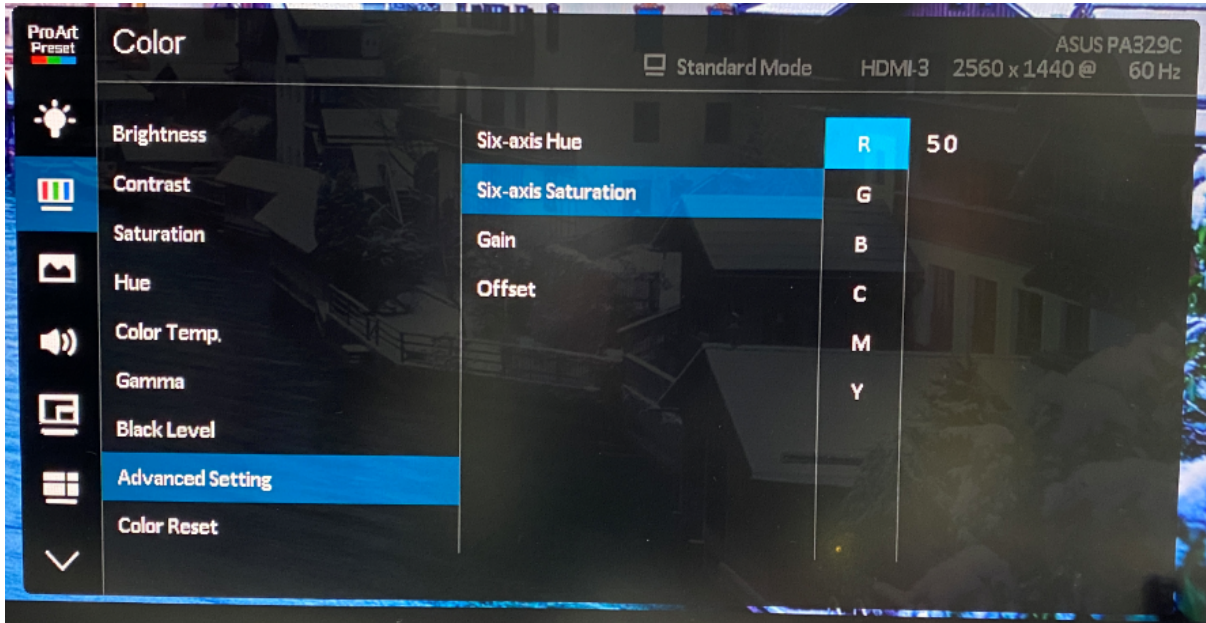
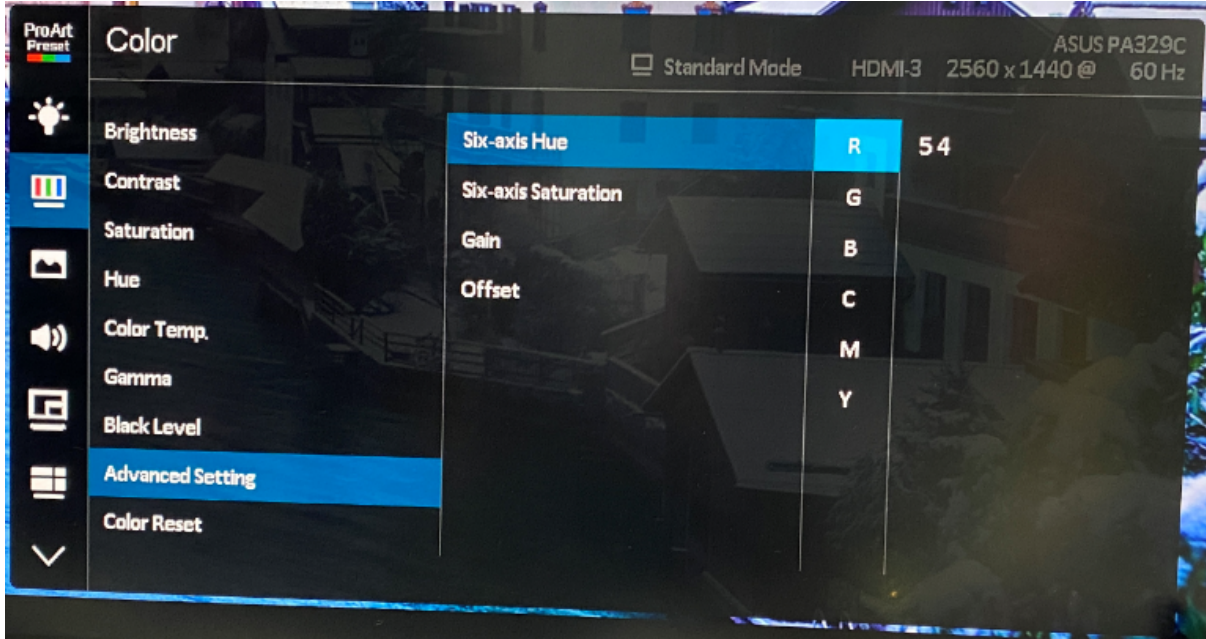
Product : PA248Q, PA24AC, PA328Q, PA329C, PA329Q, PA32UC, PA32UC-K, PA32UCX, PA32UCX_K, PA34VC, PQ22UC

What is 6-axis color control ?

ASUS features an advanced color adjustment so you can individually customize hue and saturation for each axis color under the **Scenery mode** and **Dark mode**.

For example, you can adjust the six colors (red, green, blue, cyan, magenta, and yellow) .





Category : **LCD Monitor/ Touch Screen/ Display issue**

Type : **Product Knowledge**

Was this information helpful?

YES

NO

Contact Support

Please contact with us if the above information cannot resolve your problem

Get the support

- Above information might be partly or entirely quoted from exterior websites or sources. please refer to the information based on the source that we noted. Please directly contact or inquire the sources if there is any further question and note that ASUS is neither relevant nor responsible for its content/service
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ASUS > Support > FAQ

FAQ

[ProArt Display] How to use ASUS ProArt™ Calibration Technology

Last Update : 2021/01/13 14:56

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Product : PA24AC, PA27AC, PA329C, PA329Q, PA32UC, PA32UC-K, PA32UCX, PA32UCX_K, PA32UCX-P, PA32UCX-PK, PA34VC, PQ22UC

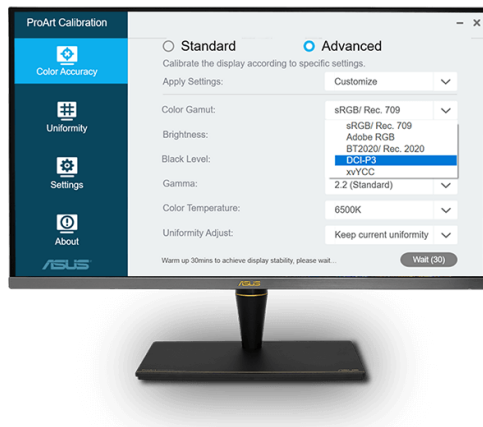
How to use ASUS ProArt™ Calibration Technology ?

What is ASUS ProArt Calibration? | ASUS SUPPORT



ASUS ProArt™ Calibration Technology





Precise, Consistent, Spectacular Colors

A calibrated and profiled display is a critical element in an efficient digital workflow for color perfectionists. However, the colors on displays decay over time so wide gamut displays are susceptible to color deviation.

ASUS now introduces a new solution - ASUS ProArt™ Calibration Technology which provides precise, consistent, and spectacular colors in the professional monitor. It's the easy way to recalibrate your display to restore its brightness and color consistency, whether it's for your desktop, laptop or Mac.

Support lists with X-Rite and Datacolor

ASUS ProArt™ calibration technology has passed internal relevant compatibility test and qualified Vendors List (QVL) , please link to [ASUS ProArt Calibration Tool - color meter support lists](#), to provide color perfectionists an easy way to calibrate the professional monitors.

Brightness and Color Consistency

The ASUS ProArt™ Calibration Technology saves all color parameter profiles on the IC chips within the monitor instead of the PC, so that you can connect your monitor to different devices without changing any settings or color shift. Meanwhile it also reduces the signal distortion between the IC & the display. It's the easy way to recalibrate your display to restore your display's brightness and color consistency.


How to Operate ?

Install the ASUS ProArt Calibration Technology software from support site.

step 1.

(1)Software installed



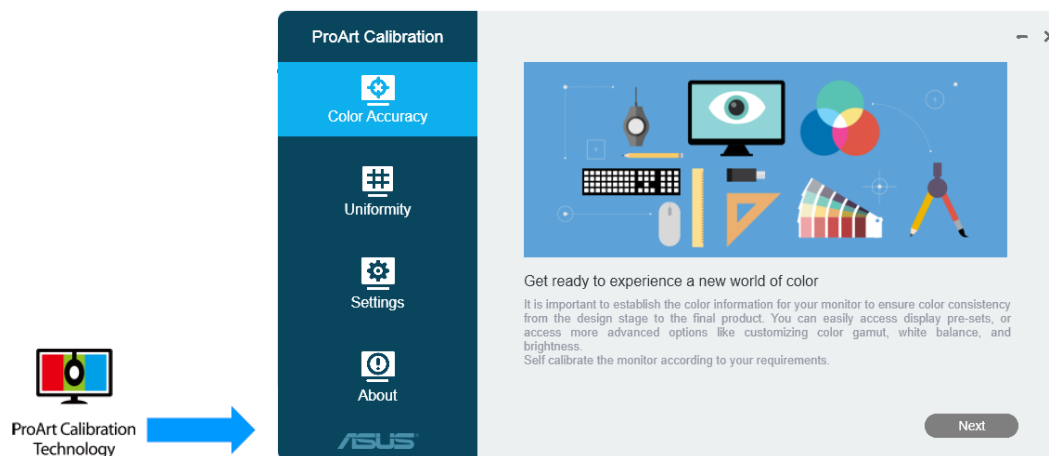
Desktop will show icon  after installation finished.

(2)(Only for PA329Q)Monitor Driver Installation-Please refer to FAQ-[\[ProArt Display\] PA329Q – Install monitor driver before executing the Calibration utility](#)

Step 2. Connect your calibrator to the monitor.



Step 3. Launch the ASUS ProArt Calibration Technology software

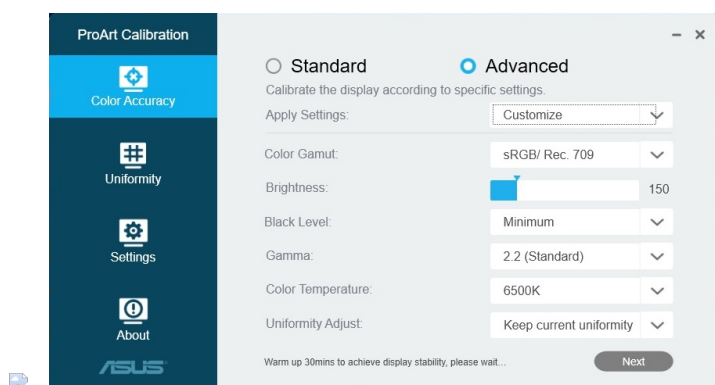


Color Accuracy

1. In the Color Accuracy section, select “Standard Mode” or “Advanced Mode”

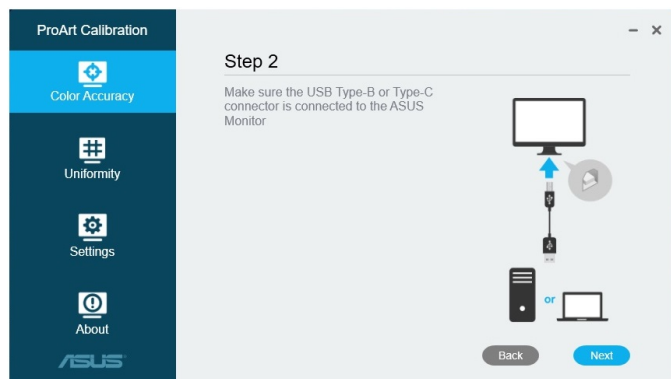
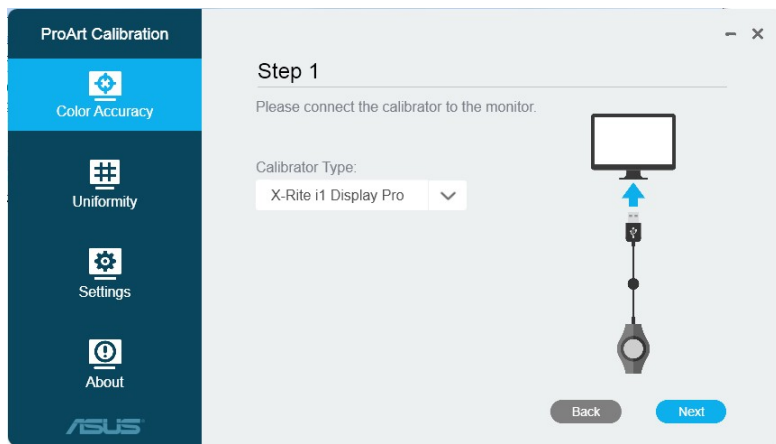
In Standard Mode, the color temperature is already set at **6500K**, **color gamma at 2.2** and **brightness at 150nits**.

In Advanced Mode, you can calibrate displays with customized parameters such as the color gamut: **sRGB (Rec 709)**, **Adobe RGB**, **DCI, BT2020 and XyYCC** are available.

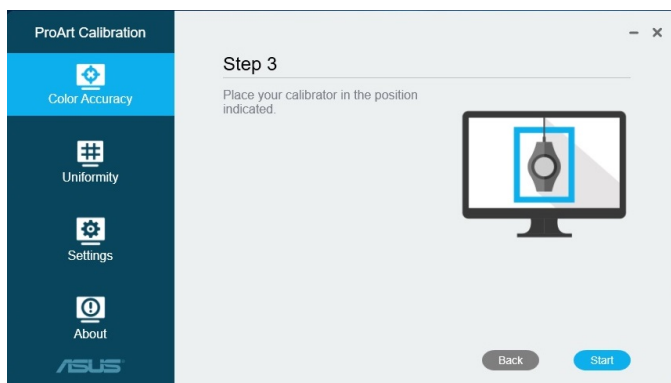


2. Choose Calibrator type and make sure the calibrator's USB Type-A is connected to the monitor& the monitor's USB type-B to A or USB type-C to A cable is connected to the computer.

(The ports and cables for each model are different, please refer to the FAQ:[ProArt Display] How to connect the computer and monitor to run ProArt Calibration?)

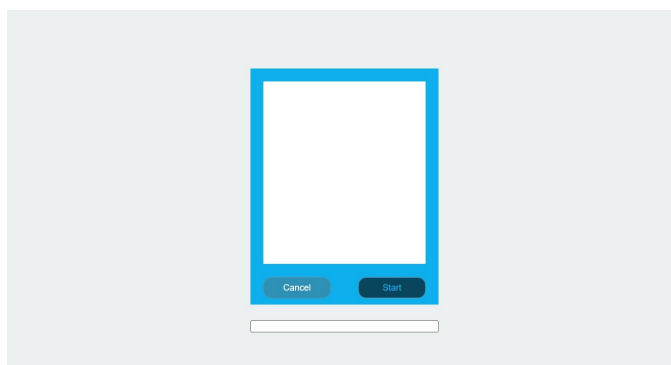


3. Click **Start** to start the calibration.



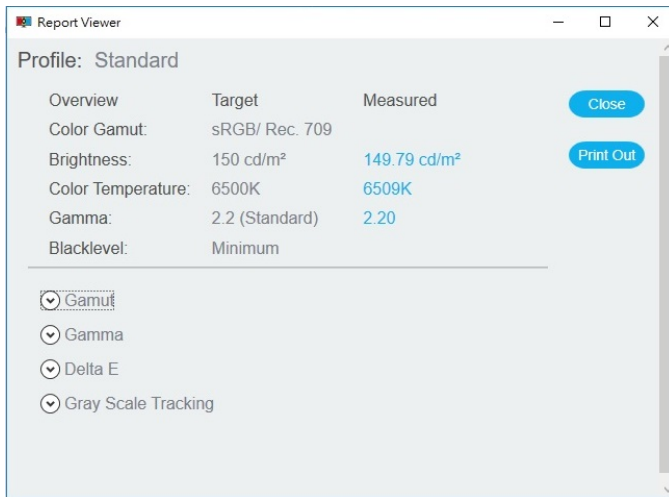
4. Place your calibrator on the panel to start the color calibration. Start the program, then **wait 5-8 mins** for the color calibration to complete.

Note: The processing time will vary due to PC efficiency.



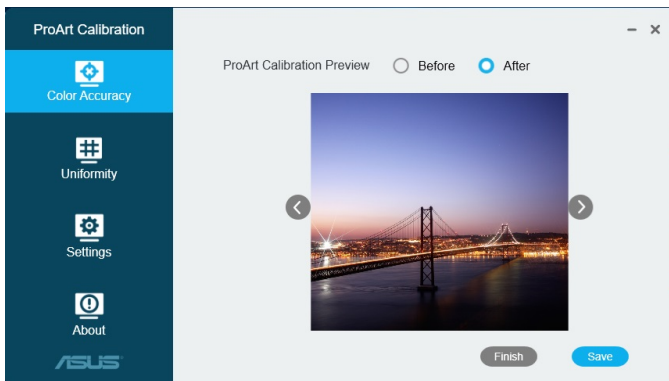
Note: If you encounter screen abnormalities during color accuracy calibration (ex: screen is completely black), please complete the second item titled Uniformity calibration and run the color accuracy calibration again.

5. Once you see the color calibration test results, you can choose to save the results report, print or save as a PDF. Please click **Print**.



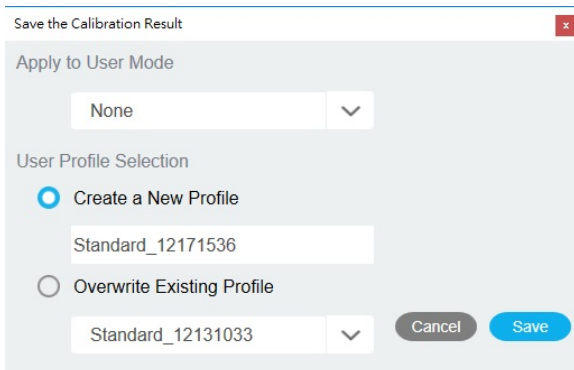
6. After clicking **Close**, you can click **Before** and **After** to check the color difference.

You can switch the Photos by clicking the left and right buttons.



7. You can click **Save** to save these setting into one of two user modes which will be linked to a monitor hotkey in Splendid mode.

You can choose **Create a New Profile** or **Overwrite Existing Profile** to save the result.



Note:

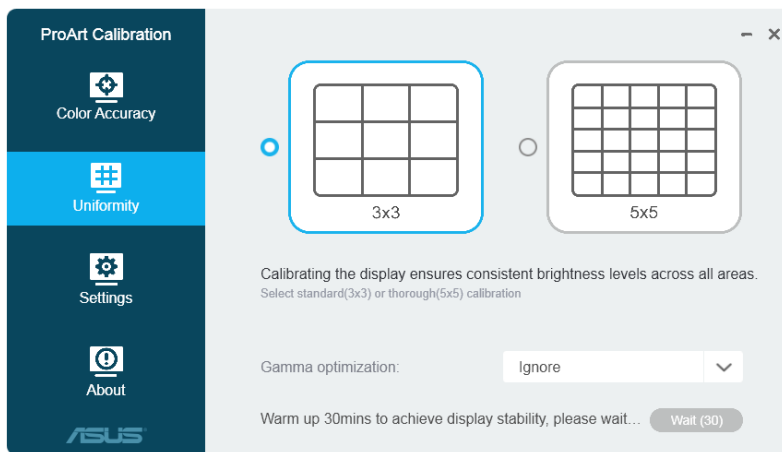
i. Each monitor can only save two user modes.

ii. The name of save color settings can only be edited in the ProArt program. The name of "User Mode 1", "User Mode 2" in the Splendid options are not editable.

Uniformity

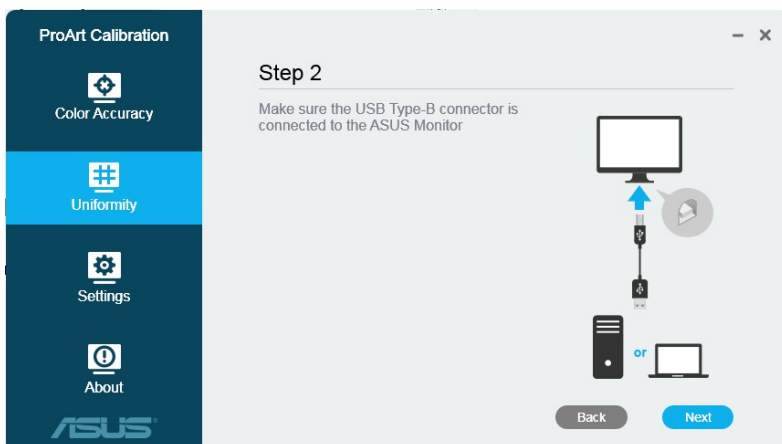
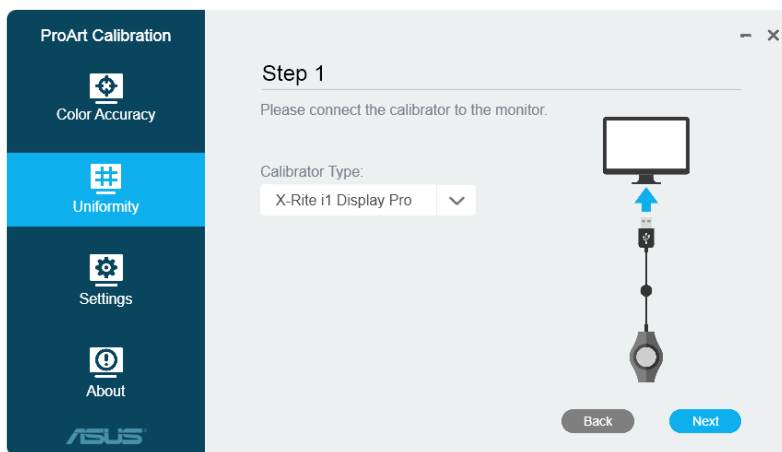
1. Select 3x3 grids or 5x5 grids in **Uniformity** session

You can have either the standard test by using a 3x3 grid or the thorough test by using a 5x5 grid to eliminate brightness and Chroma fluctuations on particular areas of the screen.



2. Choose Calibrator type and make sure the calibrator's USB Type-A is connected to the monitor& the monitor's USB type-B to A or USB type-C to A cable is connected to the computer.

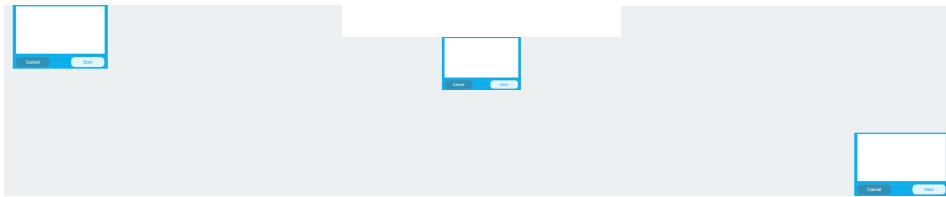
(The ports and cables for each model are different, please refer to the FAQ:[ProArt Display] How to connect the computer and monitor to run ProArt Calibration?)



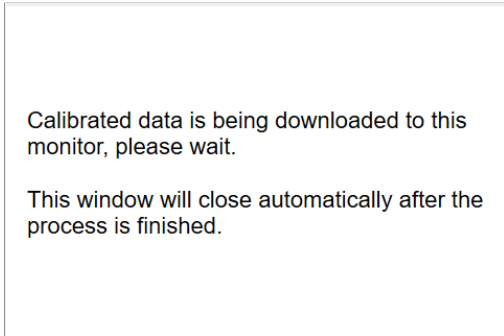
3. Click **Start** to start the Uniformity calibration.



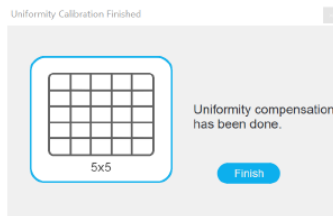
4. Move the calibrator to the marked position to start the Uniformity calibration. It may take **30-50 sec** for each grid to calibrate.



5. After all the grid calibrations are completed, the screen will show the calibrated data being downloaded. After the data has downloaded, the screen will turn back to the 3X3 or 5X5 grid test. Please move the calibrator to the marked position to complete the Uniformity calibration. (second calibration to reconfirm, each grid only takes a few seconds).



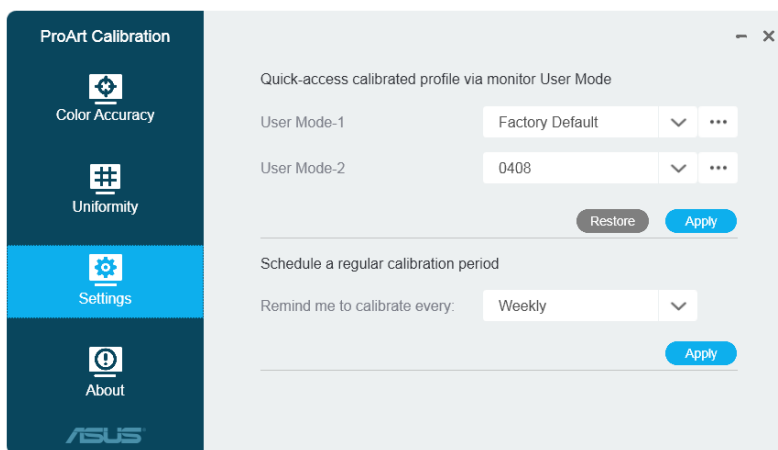
6. You'll see the test results of Uniformity calibration. The monitor will adjust uniformity compensation automatically into **both "User Mode-1" and "User Mode-2"**. After clicking finish, it will return to the home screen.



Settings

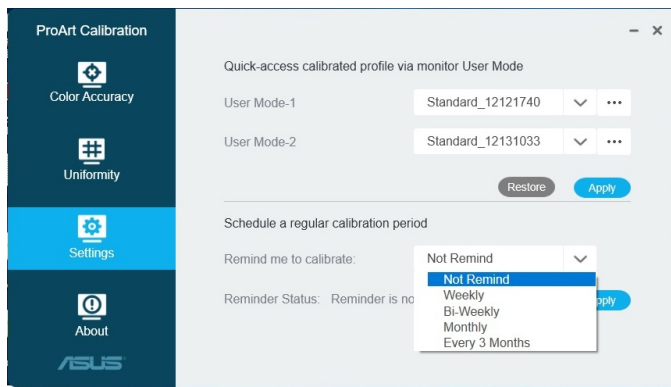
You can rename and save the calibration profiles in the user mode for quick-access.

Please click User Mode-1 or User Mode-2 to choose the calibration profile you want to access.



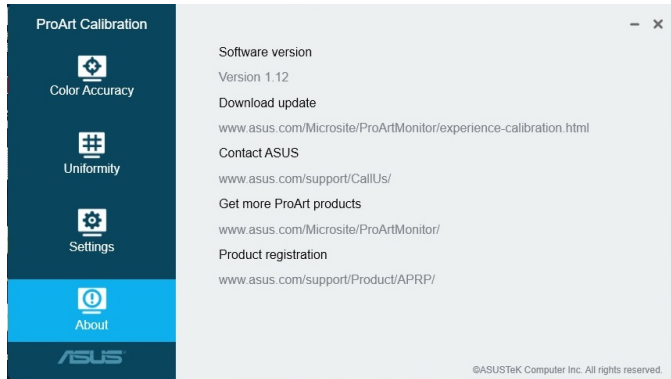
You can schedule a regular calibration in the Settings session. You can schedule weekly, Bi-weekly, Monthly, or Every 3 months.

You can choose anyone you want and click **Apply**.



About

Download the updated version of software or find more information in the “**About**” session



Category : **LCD Monitor/ Touch Screen/ Display issue**

Type : **Product Knowledge**

Was this information helpful?

YES

NO

Contact Support

Please contact with us if the above information cannot resolve your problem

Get the support

- Above information might be partly or entirely quoted from exterior websites or sources, please refer to the information based on the source that we noted. Please directly contact or inquire the sources if there is any further question and note that ASUS is neither relevant nor responsible for its content/service
- This information may not suitable for all the products from the same category/series. Some of the screen shots and operations could be different from the software versions.
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Networking
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Find Service Locations

MyASUS
Customer's request on personal data





PLAINTIFF'S
EXHIBIT
105

ASUS Display Product Introduction



Presented by Nicky Lin & Alvin Lin
2018/08/06

OUTLINE

Product Segmentation

Key Technology Roadmap

A person wearing a dark coat and boots is walking across a vast, frozen lake. The ice is cracked and textured, reflecting the sky. In the far distance, a range of snow-capped mountains is visible under a pale, overcast sky. The overall scene is serene and cold.

Product Segmentation



Hardcore
Gamer



- PG series
- XG series

Console
Gamer

- CG series

Economic
Gamer

- VG series



Hardcore Gamer



Ultra High Refresh Rate

- nVIDIA G-SYNC
- Ultra Refresh Rate
 - UHD- 144Hz
 - QHD- 165Hz
 - FHD- 240Hz
- 4ms GTG response time

Superior Performance

- G-SYNC HDR and Dynamically Control across 384 Zones Dimming
- UHD Premium
- VESA DisplayHDR 1000
- Quantum Dot Technology Boosts Wide Color Gamut (97% DCI-P3)

Gaming ID look

- Hardcore gaming ID
- ROG light projecting
- ASUS Proprietary Aura Sync Lighting Effect



**ULTRAHD
PREMIUM™**

**VESA CERTIFIED
DisplayHDR™ 1000**



High Refresh Rate Panel

- AdaptiveSync/ FreeSync/ VRR
- 3440x1440 WQHD/ 2560x1440 QHD 144Hz
- 21:9/16:9 Curved Wide-Viewing Angle Panel

Superior Performance

- 1ms MPRT (Motion Blur Reduction)
- FreeSync 2 HDR/ VESA DisplayHDR
- GameFast low input lag

Exclusive Gaming Features

- GamePlus

Gaming ID look

- Hardcore gaming ID
- ROG light projecting
- ASUS Proprietary Aura Sync Lighting Effect



Professional Monitor

Leading position

- PQ Series

ProArt

- PA Series

ProArt Biz

- PB Series

- HA Series

World 1st 4K Display



World 1st
RGBOLED Monitor



*Content Creator
Photography
Video Production*





ProArt Professional Display

Outstanding performance

- Multiple dynamic dimming: up to K zones
- Multiple HDR formats support: PQ, HLG, Dolby Vision
- High peak luminance: 1,000 nits

Wide Coverage & Accuracy Color

- Pre-calibrated $\Delta E < 2$
- W/R/G/B Uniformity
- Gray level tracking
- Wide color gamut technology: 99.5% Adobe RGB, 99% DCI-P3
- ASUS ProArt Calibration

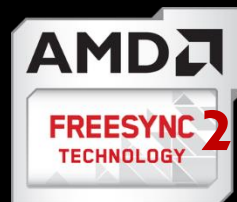
Connection without Boundary

- DP1.2, HDMI 2.0b, Dual Thunderbolt™ 3, USB 3.0 Ports
- Daisy chain ability
- PIP/PBP multiple frames simultaneously





A person in a dark coat and boots is walking across a vast, flat, frozen lake. The surface of the ice is cracked and textured. In the far distance, a range of snow-capped mountains is visible under a pale sky. The person's reflection is visible in a small pool of water on the ice.

Key Technology Roadmap



Dynamic Refresh Rate

			VESA AdaptiveSync	HDMI 2.1 VRR
Requirement	NVIDIA G-Sync Module + NVIDIA qualified panel	Capable scaler IC + capable panel	Capable scaler IC + capable panel	Capable scaler IC + capable panel
	DisplayPort interface only	Displayport interface HDMI interface	Displayport interface HDMI interface	HDMI 2.1
	G-Sync partners	Certification needed	Open Standard	Open Standard
	Non-Disclosure	Dynamic refresh rate range $\geq 48\text{Hz}$	No VRR range limit	No VRR range limit
Mechanism	Non-Disclosure	DP-MSA (Main Stream Attribute) ignored BlankStart/BlankEnd tracking HDMI-SPD (Source product descriptor) InfoFrame	Similar with FreeSync	SPD (Source product descriptor) InfoFrame
Performance	The highest refresh rate hitting: 4K 144Hz	Focus on 48Hz~120Hz+ refresh rate	No dedicated	No dedicated
Cost	◎	○	△	△



Exclusive Aura Sync



Enjoy synchronizing up to 12 lighting effects between all Aura-ready motherboards, gaming graphics cards and the ever-growing portfolio of Aura-capable peripherals.

Back



Front



Static



Breathing



Strobing



Flash & dash



Wave



Glowing Yo Yo



Rainbow



Color cycle



Comet



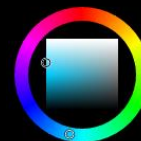
Starry night



Music effect



CPU Temperature



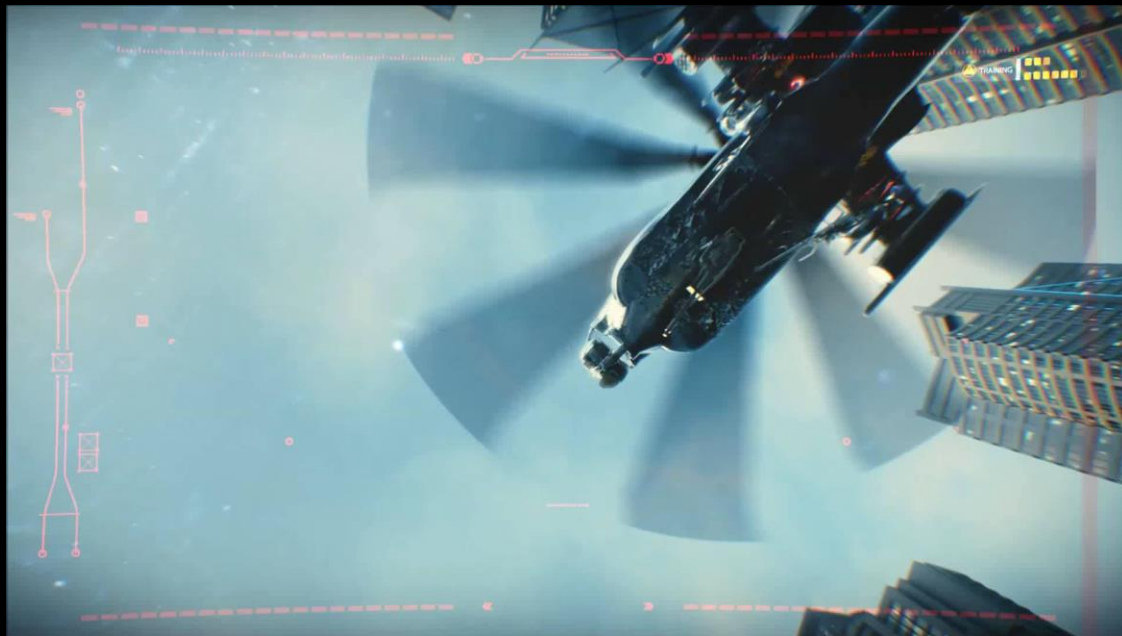
Customizable Light Signature



ROG Light
Signature



World's First 240Hz Gaming Monitor



Conventional

240Hz Refresh Rate



Exclusive GamePlus*

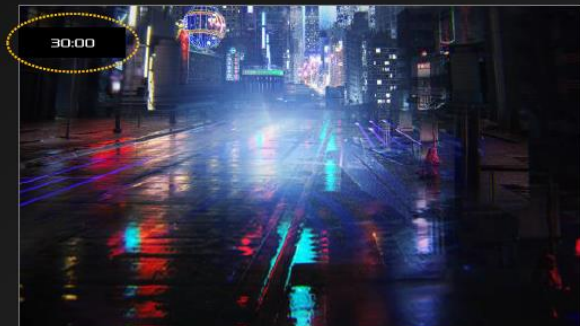
- **Crosshair**

You can choose between four persistent crosshairs and fine tune their position, ensuring pinpoint accuracy in first-person shooters. Enjoy perfect aim even when the game doesn't provide its own crosshair or sights.



- **Timer**

The on-screen timer keeps tabs on recurring drops, respawns, and other time-based events. And you can move it anywhere on the screen with the navigation joystick to make sure it doesn't interfere with the in-game HUD.



**These tools allow gamers to practice and improve on their gaming skills.*

ASUS

Exclusive GamePlus

- FPS counter**

Shows the rate at which frames are being drawn by the display. This information can be used to evaluate the performance impact of different graphics settings and system configurations, so you can fine-tune the balance between in-game visuals and frame rates.



Note: The FPS counter functions while G-Sync is on.

- Display Alignment**

When activated, three lines appear on all four sides of the PG27UQ in order to eliminate any guesswork in lining up each monitor in your multi-display set-up perfectly.



Display HDR Standards / Formats



HLG



More Standards are Coming...

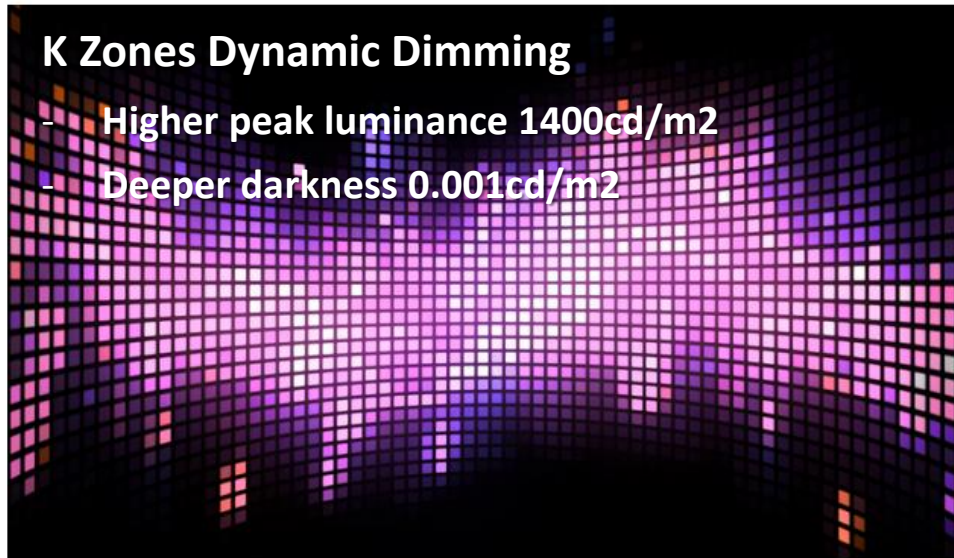


ProArt mini-LED



K Zones Dynamic Dimming

- Higher peak luminance 1400cd/m²
- Deeper darkness 0.001cd/m²



PA32UX

2019

PA27UX



2020

PA27AX

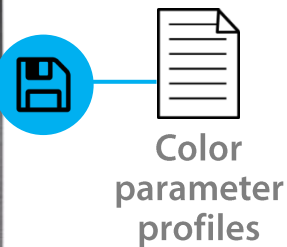
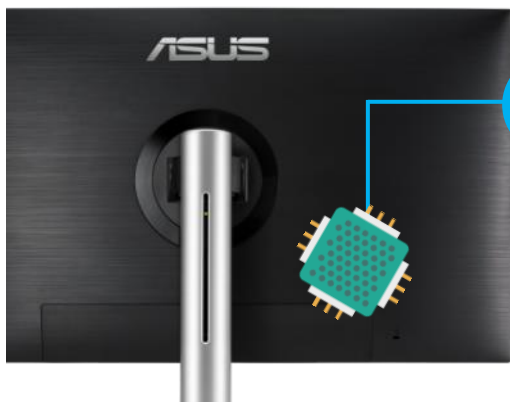


PA24AX

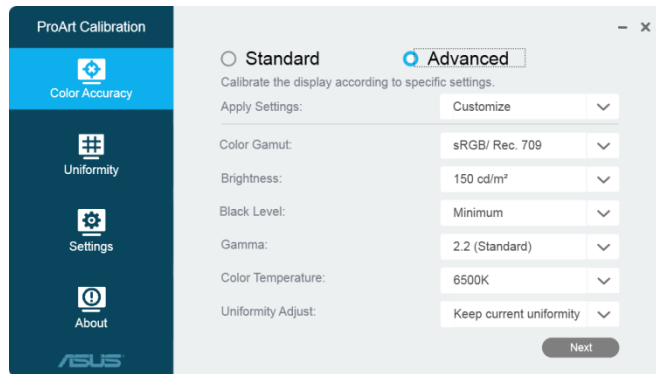




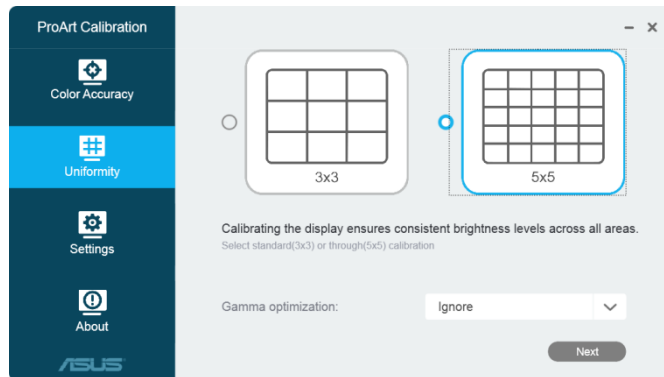
HW Calibration solution



Color Accuracy



Uniformity





More Speed. More Pixels. More Possibilities.



The USB-C That Does It All

More Speed

40 GB/S

More Possibilities

USB 3.1 / DP

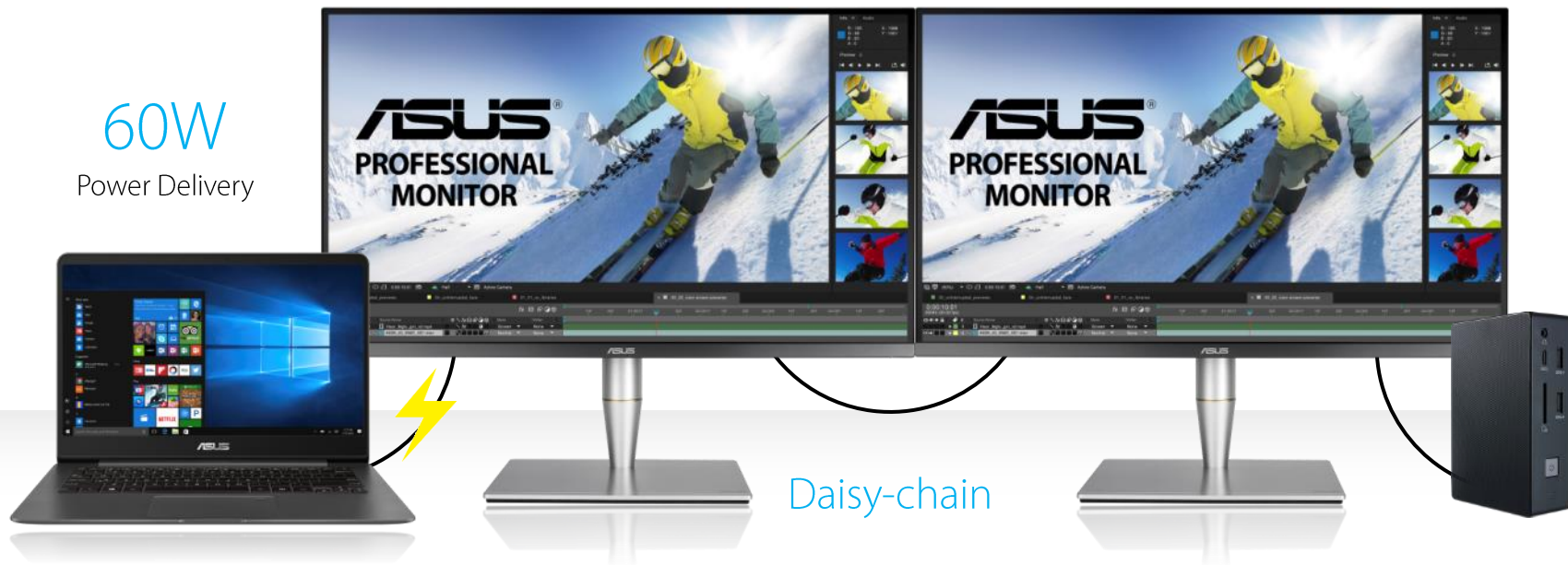
Signal

More Pixels

Dual 4K Display
Daisy-chain

Multi-display setups

Through the Thunderbolt™ 3 interface supports DisplayPort, USB3.1 data transmission & 60W power delivery multiple functions simultaneously.



A person in a dark coat and boots is walking across a vast, frozen body of water, likely a lake or sea. The ice is a deep blue color with visible cracks and textures. In the background, a range of snow-capped mountains stretches across the horizon under a pale sky. The person's reflection is visible in the wet patches of the ice.

THANKS



Gaming LUT

Selective Color Enhancement

Change specific colors that are seen in a game

- Gamer chooses the colors that need to stand out
- Allows objects in the game to be seen easier



Before



After

User Interface

- Load image
 - Show a screenshot of the game so colors that need to be enhanced can be selected (see next slide)
- Manual entry
 - Advanced users can manually enter RGB values
- Slider
 - Adjust the amount of similar colors that will be affected
- Narrow/Wide
 - Adjust pixels close to (narrow) or farther from (wide) the pixels of color to be enhanced
- Generate profile
 - calculate/save 3D LUT
- Upload profile
 - Apply profile to screen

Game LUT

Load image Manual entry

235, 0, 6 - + 50 Narrow Wide Remove

0, 255, 125 - + 5 Narrow Wide Remove

Generate profile Update profile

Choose Colors to Enhance

- Load image
 - Select an image
- Color Values
 - Select a field to assign a color
- Target cursor
 - Move and click to select a color to enhance
- Add color
 - Adds selected colors to the UI

